YAZOO-MISSISSIPPI RIVER BASIN STUDY
MISSISSIPPI

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE
IN COOPERATION WITH OTHER FEDERAL AND STATE AGENCIES
JACKSON, MISSISSIPPI JUNE 1975

YAZOO-MISSISSIPPI RIVER BASIN STUDY
MISSISSIPPI

Prepared by

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Economic Research Service
Forest Service

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PREFACE

This study encompasses the entire Yazoo River Basin located in the State of Mississippi. The report contains a description of the basin's resources and identifies problems, needs, and alternative solutions for meeting the problems and needs. A recommended early-action plan and a long-range plan was formulated to schedule development features. The study emphasizes the need for coordination between the Corps of Engineers and the Soil Conservation Service's planning efforts and project installations. The most critical problem areas and needs requiring close planning and coordination are identified.

A supplemental study for part of the basin has been approved. This study will investigate the need for additional flood damage reduction and the control of erosion and sediment. All alternatives solutions and recommended plan elements will be coordinated with the Corps of Engineers' planned and installed outlets and other structural measures.

This supplemental area includes all of the upland area below the Corps of Engineers' reservoirs and the delta area east of the Yazoo, Tallahatchie, and Coldwater Rivers. These areas are referred to in this study as areas 9, 8E, and a small part of area 8W below Yazoo City.

This supplemental study begins in July, 1975. The scheduled completion date depends to some extent on the progress of the present Corps of Engineers' study in the Yazoo Basin. The Corps' study will provide data on proposed schedules for the planning and installation of their projects. These schedules and project measures will control the planning and installation of USDA projects. The present supplemental USDA study extends for a period of about two years but will be controlled by the above items if full coordination occurs.

A supplemental report will be prepared and study results will be limited to specific items that relate to the objectives of the supplement. It is expected that the report will recommend in greater detail means of reducing flood damages, be more specific concerning reduction of erosion and sediment problems, and provide a proposed schedule of watershed projects for future planning that is fully coordinated with the Corps of Engineers' planning and installation priorities.

ADDENDUM NUMBER 1
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This addendum shows the results of using an interest rate of 5 7/8 percent for a 100 year evaluation period to determine benefits and costs for the early action plan. In the report 6 7/8 percent interest with a 100 year evaluation period was used in the upland and Delta areas whereas 5 1/2 percent interest was used for streambank stabilization. Current normalized prices were used to determine benefits in all cases.

Comparison of annual benefits to annual costs

Areas and item	Total: Annual benefits	Total: Annual costs	Benefit to cost
	Dollars	Dollars	Ratio
Upland areas	5,641,164	2,459,400	2.3:1
Delta areas	8,034,800	2,499,600	3.2:1
Streambank stabilization	3,691,700	2,141,400	1.7:1

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SUMMARY

Objective and Scope

The objective of this study is to aid in the orderly development, utilization, conservation, management and protection of water, land, and related resources. The study includes descriptions of problems, needs, and solutions. Major emphasis is placed on plan measures that can be implemented through USDA programs. These measures include floodwater retarding structures, channels, land stabilization, and land management systems. Other measures are proposed to protect the environment, preserve archeological and historical areas, and provide recreational facilities.

Location and Size

The Yazoo-Mississippi River Basin consists of the entire drainage area of the Yazoo River and is located in the northwest portion of Mississippi. The basin is made up of 8.5 million acres of land and water lying between the Mississippi River Levee on the western side, the Hatchie and Wolf River Basin divides on the northern perimeter, and the Tombigbee and Big Black River Basins on the eastern and southern boundaries. All waters in the basin drain through the Yazoo River into the Mississippi River near Vicksburg. Major tributaries of the Yazoo are the Coldwater, Tallahatchie, Yalobusha, and Sunflower Rivers.

Natural Resources

The climate is basically a humid, subtropical one with abundant precipitation. An average rainfall of 52 inches falls annually on the basin. The greatest amount normally occurs during the months of December to April and the least during September and October.

The average annual temperature ranges from 65.9° F at Vicksburg to about 60.4° F at Holly Springs. The growing season averages about 250 days at the southern part of the basin to about 215 days in the northern part. Basinwide, the average annual growing season is about 230 days.

There are three major land resource areas in the basin. They are the Southern Mississippi Valley Alluvium (LRA 131), the Southern Mississippi Valley Silty Uplands (LRA 134), and the Southern Coastal Plain (LRA 133). The delta (LRA 131) is a highly specialized agricultural land resource area. The land is level to gently sloping and highly fertile. Thus, farmers can arrange, rather easily, large fields which are almost level and therefore suitable for the operation of heavy farm equipment. The soils in LRA 134 developed from windblown materials. A combination of high soil fertility, good physical properties, and favorable climate make these soils capable of providing high yields of many crops. The soils in LRA 133 are made up of sand, silt, clays, shale, and some gravel. The topography varies from level to steep. The steep land is better suited to trees than for cultivated crops. Soils are generally low in fertility.

A variety of game species are found in the basin. The pine and mixed hardwood forests of the upland area and the bottomland hardwoods of the alluvial delta support good populations of deer, wild turkeys, and small forest game and nongame wildlife species.

The streams and natural lakes of the delta area as well as farm ponds and four large man-made lakes in the uplands area provide excellent sport and commercial fishing opportunities. Largemouth bass, spotted bass, white bass, white crappie, bluegill, and catfish are the most important game fish. Catfish and buffalo fish are the major commercial species.

Migratory waterfowl are seasonably abundant on the four large lakes in the uplands and on natural lakes of the delta. Large numbers of these migrant waterfowl are attracted to flooded forest areas during the fall and winter months. Wood ducks are year round residents of the forest areas near permanent water.

Currently, oil and gas output in the southern part and widespread production of construction minerals define the mineral industry activity in the basin. Sand and gravel are produced in more than half the counties in any year to meet local needs. Clay is produced in several counties and stone is produced in one county.

Significant environmental features include essentially undeveloped landforms, water bodies, and forests. There is a very small amount of open and green space in the urban areas of the basin. Few of the rivers and streams possess outstanding scenic qualities. There are virtually no natural lakes in the upland area of the basin. The delta, however, has a lot of natural lakes. McIntyre Scatters is the only area closely resembling a true wilderness area. This area as well as several others abound with deer, squirrel, waterfowl, and other game species.

There are about 1.1 million acres of bottomland hardwoods scattered throughout the basin. Most stands are in small privately-owned blocks and strips along lakes and streams.

Economy

The population of the basin grew steadily from 1870 to 1940, reached its pinnacle in 1940 and since has gradually declined. Basin population was about 561 thousand in 1970 and is projected to increase to 779 thousand in the year 2020.

The mechanization of agriculture released thousands of workers to the labor market and with no available jobs they migrated out of the basin. However, in recent years the economy has become more diversified and new industries have located in the basin. These industries provide jobs and thus have helped stem the out-migration of residents and reverse the population trend.

An increasing number of people are employed in industries other than agriculture. Agricultural employment is projected to decline from about 38 thousand in 1970 to 18 thousand in 2020 while manufacturing employment is projected to increase from 46 thousand to 82 thousand during the same period.

Total personal income was about $1.1 billion in 1970 and is projected to increase to about $8.2 billion in 2020. In past years, the principal source of personal income has been from agriculture but in future years it will be from manufacturing and services.

Per capita income has historically been below the national average. Basin per capita income was about two thousand dollars in 1970 while the U. S. average was about four thousand dollars. It is projected that the basin average will be only 74 percent of the U. S. average by 2020.

Problems, Needs, and Solutions

A summary of problems and needs is listed in table S.1. Major problems are flooding of 4.8 million acres that cause $45.8 million of damages to the basin's economy and resources. Erosion and sediment affects 2.9 million acres and there are 4.1 million acres with a wetness hazard.

Principal needs include adequate land to sustain food and fiber production and future expansion of urban and built-up areas. Land treatment measures are required to insure production and to protect the land resource base.

A recommended plan was formulated to meet the needs of the basin to the year 2020. An early action plan was prepared extending to the year 2000. A summary of early action plan measures is shown is table S.2. A display of selected effects of the early action plan is presented in table S.3.

Conclusions

Some environmental quality component needs will have to be implemented by other programs outside present USDA authorities. These relate primarily to ecological areas, archeological and historical preservation, preservation of bottomland hardwood areas, and some recreational facilities.

Considerable land conversion will be required to provide for the land use needs for cropland and pastureland. Forest acreages and other lands will be drastically reduced to provide for other land uses. Wildlife habitat will be lost by land use conversions creating needs for suitable habitat.

The problems of streambank erosion along the bluff streams and flooding of delta areas from the runoff of these streams are different and more acute than in the rest of the basin. These problem areas are related closely to Corps of Engineers projects. Coordination between this agency and the Soil Conservation Service must occur to insure adequate solutions for these areas where projects are planned.

Table S.1. Summary of major problems and needs, Yazoo-Mississippi River Basin

Item	Units	Quantity
Problems (1970)		
1. Flooding		
Upstream watershed	Acres	1,973,000
Principal streams	Acres	2,800,000
2. Erosion and sediment		
Sheet and gully erosion	Acres	2,877,500
Roadbanks	Acres	8,200
Streambanks	Miles	2,767
3. Wetness hazard	Acres	4,146,500
Needs (early action plan, 1970-2000)		
1. Land		
Cropland	Acres	3,638,500
Pasture	Acres	1,449,200
Other land	Acres	230,000
Urban and built-up area	Acres	361,000
Forest	Acres	2,578,400
2. Associated land treatment measures		
Cropland and pasture	Acres	2,100,000
3. Improved timber management		
Tree planting	Acres	173,000
Stand improvement	Acres	84,000
4. Recreation facilities		
Land	Acres	116,862
Water	Acres	2,183
5. Fish and wildlife		
Fishing	Man-days	0
Hunting	Man-days	437,076

Table S.2. Summary of early action plan measures, relation to total recommended plan measures, and program opportunities, Yazoo-Mississippi River Basin, 1970-2000

Program and Plan Measures or Needs	Units	Plan: Early Action 1970-2000	Plan: Recommended by year 2020	Program Opportunities
USDA Programs				USDA (Each program may apply to more than one measure or need)
1. Floodwater retarding structures	Number	227	464	Public Law 46 (technical assistance)
2. Channels	Miles	2,119	4,734	Public Law 534 A/O with FmHA loans
3. Associated land treatment	Acres	1,064,000	2,100,000	Public Law 566 A/O with FmHA loans
4. Gully and critical area stabilization	Acres	294,000	392,100	RC&D Projects A/O with FmHA loans
5. Streambank stabilization	Miles	340	340	U.S. Forest Service (State and Private)
6. Roadbank stabilization	Acres	8,200	8,200	Cooperative Forest Management (CFM)
7. Other conservation management systems	Acres	1,000,000	1,500,000	Tree Seedling Production (CM-4)
8. Grade stabilization structures	Number	4,785	4,785	General Forestry Assistance (GFA)
9. Tree planting	Acres	173,000	173,000	ASCS
10. Timber stand improvement	Acres	84,000	84,000	Note: All of these programs require
11. Animal waste treatment units	Number	895	895	local participation such as individ-
Total average annual cost	Mil.dol.	18.6	N/A	uals, Soil Conservation Districts,
				and Drainage Districts
Others				Others (Programs of the agency or groups may apply to more than one item)
1. Protect bottomland hardwoods	Acres	201,000	201,000	Federal agencies
2. Protect geological system -				State agencies
(Delta Bluff Hills)	Acres	1,100	1,100	County agencies
3. Protect forest along recreation trails	Acres	70,000	70,000	City
4. Preserve wilderness area -				Drainage Districts
(Delta National Forest)	Acres	5,000	5,000	Soil Conservation Districts
5. Develop urban and green space	Acres	8,000	8,000	Individuals
6. Preserve ten ecological systems	Acres	9,900	9,900	Other Groups
7. Protect twenty-one lakes - flat water	Acres	21,400	21,400	
shore lines	Acres	1,735	1,735	
8. Recreation facilities - land area	Acres	116,862	144,600	
water area	Acres	2,183	2,700	

Table S.3. Display of selected effects of early action plan, Yazoo-Mississippi River Basin, 1970-2000

Account	Selected Effects		
1. National Economic Development	Beneficial effects	$17,487,000	Annually
	Adverse effects	$ 9,316,000	do
	Net beneficial effects	$8,171,000	do
2. Regional Development	Income:		
	Beneficial effects	$21,348,000	Annually
	Adverse effects	$ 3,064,000	do
	Net beneficial effects	$18,284,000	do
	Employment:		
	7,042 man-years of semi-skilled jobs		
	125 permanent semi-skilled jobs		
3. Social Well-Being	Real Income Distribution:		
	1. Create 125 low to medium income permanent jobs for basin residents.		
	2. Create regional income benefit distribution of $21,348,000.		
	3. Local costs, to be borne by basin, total $3,064,000.		
	Life, Health, and Safety:		
	1. Increase outputs will be in soybeans, rice, cotton, and in livestock products.		
	2. Reduce flood hazard on 970,000 acres.		
4. Environmental Quality	1. Provide flood protection on 970,000 acres.		
	2. Construct 227 floodwater retarding structures which provide sediment storage and affect the land use on 32,620 acres.		
	3. Construct 2,119 miles of channel and reduce quality and quantity of fish and wildlife habitat.		
	4. Create 81,000 acres of large water.		
	5. Reduce erosion on 294,000 acres of critical areas and gullies.		
	6. Reduce erosion on 1,000,000 acres of cropland and pastureland.		
	7. Stabilize 340 miles of streambanks.		
	8. Convert 643,600 acres of forestland to other land uses.		
	9. Deterioration of wildlife habitat from land use conversions.		
	10. Protect 21 lakes and shorelines.		
	11. Protect 201,000 acres of bottomland hardwood.		
	12. Develop 8,000 acres of urban open and green space.		

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CHAPTER I

INTRODUCTION

This report by the U. S. Department of Agriculture evolved from a cooperative survey and contains an early action plan for the water and related land resources of the Yazoo-Mississippi River Basin. It is based upon studies made by agencies of the U. S. Department of Agriculture and reports and information acquired from other federal, state, and local agencies. The purpose is to guide the orderly development of water and related land resources of the basin to keep abreast or slightly ahead of the need placed on the available resources.

The need for the development of water and related land resources results from economic and resource losses as well as social losses of an intangible nature. Need arises from such occurrences as water shortages, water surpluses, deficiencies in water quality, land losses due to water action, and inefficiencies and misuse of both water and related land.

Background of the Study

The U. S. Department of Agriculture has conducted studies on portions of the Yazoo-Mississippi River Basin since 1958. Over the years, more and more problems have been investigated and solutions sought. As a result, the geographic area studied increased from approximately 6 million acres to 8.5 million acres.

A map of the basin is shown following page 1-6, and the delineation of areas studied during the period 1958 to 1975. Areas 1 through 9 were studied during the period January 1, 1958, through 1960. The study area comprised approximately 6 million acres, of which approximately 4.5 million acres were within the Yazoo-Mississippi floodplain and approximately 1.5 million acres in the Bluff area.

A restudy was begun in 1968 at the request of the Mississippi Board of Water Commissioners and other local, state, and federal agencies. In October 1970, local interests and the Mississippi Board of Water Commissioners requested an expansion of the study area to include the remaining portion of the Yazoo - namely, that area above the four flood control reservoirs constructed by the Corps of Engineers.

The following description briefly summarizes the study time frames and general purpose:

Study 1958-1960 - The purpose of this study was to develop and obtain, through surveys and investigations, necessary information to be used by USDA in coordinating its programs with soil conservation districts, agencies of the state government, and with other federal agencies; and to be used by the Board of Water Commissioners to effectively administer and assist in planning the physical and economic aspects of water use and management in the Yazoo-Mississippi River Basin as applies to Chapter 167, Mississippi Laws of 1956.

Study 1968-1970 - In September 1967, local, state, and federal agencies resolved that there was a need to re-evaluate the opportunities for soil and water development, utilization, conservation, and management in the basin. The developments that had taken place in the basin since 1960 far surpassed estimates made in the previous study and there was a greater need to plan for the future. It was felt that emphasis should be placed on recreation, fish and wildlife, sources and availability of water, water quality, and environmental considerations.

Study 1970-1975 - At the September 1970 meeting of the Board of Water Commissioners, the Department of Agriculture was requested to expand the study area to include the upper watershed to encompass the entire Yazoo-Mississippi River Basin. The area added consists of approximately 2.5 million acres and are numbered areas 10 through 13 on map 1.1 following page 1-6.

Objective

The primary objective of the study is to develop a plan for use in facilitating the coordinated and orderly conservation, development, utilization, and management of the water and related land resources of the basin. Achievement of this objective required a general appraisal of the overall water and related land resource problems, needs, and development potentials of the basin and included the following items:

1. An inventory of resources.

2. An appraisal of environmental conditions.

3. Studies and projections of economic development.

4. Translation of such projections into needs for water and related land resource uses.

5. Appraisals of the availability of water supplies both as to quantity and quality.

6. Appraisals of the availability of related land resources.

7. A description of the characteristics of present and future problems and the general approaches that appear appropriate for their solution.

8. Formulation of a multi-objective plan for the orderly development of the water and related land resources of the basin.

9. Identification of projects which need to be initiated during the next 10 to 25 years.

10. Studies to determine the extent to which recreational, fish and wildlife habitat improvement, flood control, drainage, irrigation, rural municipal and industrial water supplies, and water quality control can be provided by water and related land resource development programs in upstream areas and along the main streams and principal tributaries to satisfy the demands and to maintain and improve the environment.

11. A compilation of economic, hydrologic, engineering, environmental, and related data to assist the State of Mississippi and local groups and organizations in planning the wise use of natural resources commensurate with the desires of the people.

Authority

The Department of Agriculture participated in this study under authority of Section 6 of the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566, as amended) which authorizes the Secretary of Agriculture to cooperate with other federal, state, and local agencies in their investigation of watersheds, rivers, and other waterways to develop coordinated programs. The study was sponsored by the Mississippi Board of Water Commissioners.

Participants

The principal participants within the U. S. Department of Agriculture were the Soil Conservation Service, the Economic Research Service, and the Forest Service. The personnel assigned to the River Basin Survey Staff by the three USDA agencies functioned as a planning team under the guidance of the USDA Field Advisory Committee. Each agency had leadership responsibilities for designated aspects of the survey as outlined in an adopted plan of work.

Participation of the USDA agencies was carried out in accordance with assigned responsibilities and coordinated through the Field Advisory Committee. The Committee members maintained appropriate liaison with the administratively responsible officers of their respective services in carrying out this survey. The Committee also maintained liaison with the co-sponsors to assure coordination of the planning activities.

Participation by the sponsors and other state and federal agencies contributed to the study. A sponsor representative attended the Field Advisory Committee meetings and made his views known during the study. Also, they assisted in the study by securing data from other state and local agencies and by transmitting copies of the draft to these agencies for review and comments. In addition, the Board assisted in preparing the plan of work which set forth the objectives of the study. During the selection of alternative solutions for some of the major problems, the Board assisted.

Other agencies and groups assisted by furnishing data or by reviewing data and commenting during the study, as well as reviewing and commenting on the drafts of the study. Plan formulation and selection of alternatives developed over a long period of time and was accomplished in an informal manner.

Nature, Scope, and Intensity of Investigations

This study was limited to investigations to establish the general type, size, location, and priority of measures needed to accomplish flood control and prevention, drainage, recreation, fish and wildlife development, land use, and changes to reduce sedimentation and improve water supply. Secondary data and other studies were used whenever possible and available. The study was comprehensive to the extent that major purposes of water and related land resources development were considered. However, the study deals primarily with solutions to problems that can be implemented by the U. S. Department of Agriculture. It also makes recommendations concerning additional needs that will have to be met by other programs. Economic development was considered only to the extent necessary to determine the proper role for water and related land.

The Department of Agriculture agencies analyzed historical information and developed projections of the following major indicators: (1) volume and value of agricultural output, including timber productions; (2) income and employment in basic agricultural and forestry activities; (3) use of rural lands including the acreage devoted to major crops, forest production, recreation, and fish and wildlife; and (4) employment, income, and other measures of economic activity directly related to the basic agricultural and forest industries.

The appraisal of agricultural and rural community water problems and development needs were based on economic studies and needs. The determination of resource development needs required; (1) a physical inventory of the nature, distribution, and extent of agricultural and rural community water problems; (2) appraisals of economic losses sustained by farmers, households, and related trade and service centers which result from these problems under present and projected patterns of land use and development; (3) appraisals of the markets for products and services obtainable from the use of water and related land resources; and (4) estimates of the costs of obtaining the desired products or services from various types of more intensive uses or from development of available supplies of water and related land.

Hydrologic studies were made in cooperation with other agencies to determine current water supplies and projections of future water availability. Reconnaissance studies were made on the amounts of sediment that would enter the stream system at selected points in the basin.

The current and future (1980, 2000, and 2020) land requirements for specific uses were determined. The estimated land needs were compared with the areas of land of various types and capabilities available in the basin. Both federal and state agencies with responsibilities for management of public lands cooperated in this appraisal.

Potential solutions to water and land related problems include both structural and non-structural measures. Project and non-project type action was considered. Individual watershed projects found to be needed and economically feasible under present criteria were identified. Their sizes, purposes, and cost-sharing arrangements are compatible with projects planned and installed through Public Laws 566 and 534.

Delineation of Basin Subareas

For the purpose of identifying flood problems, sediment problems, existing watershed projects, and certain other elements, the basin was sub-divided into 13 areas. Areas 1 through 7 consist of the Big Sunflower River, Steele Bayou, and Deer Creek drainage. Areas 8 through 13 consist primarily of the Yazoo River drainage. Also, some grouping of areas and sub-dividing of other areas was necessary to properly identify the elements of the study. Other sub-divisions of the basin were made for other purposes but conflicts generally do not exist.

The delta subarea consists of areas 1 through 8. Area 8 was sub-divided into area 8E and 8W for the purpose of identifying the

Yazoo River Watershed, a flood prevention project. Area 8E makes up the delta part of the Yazoo River flood prevention project.

The bluff subarea consists of area 9. The part of area 9 below Yazoo City, Mississippi, is outside of the Yazoo River flood prevention project.

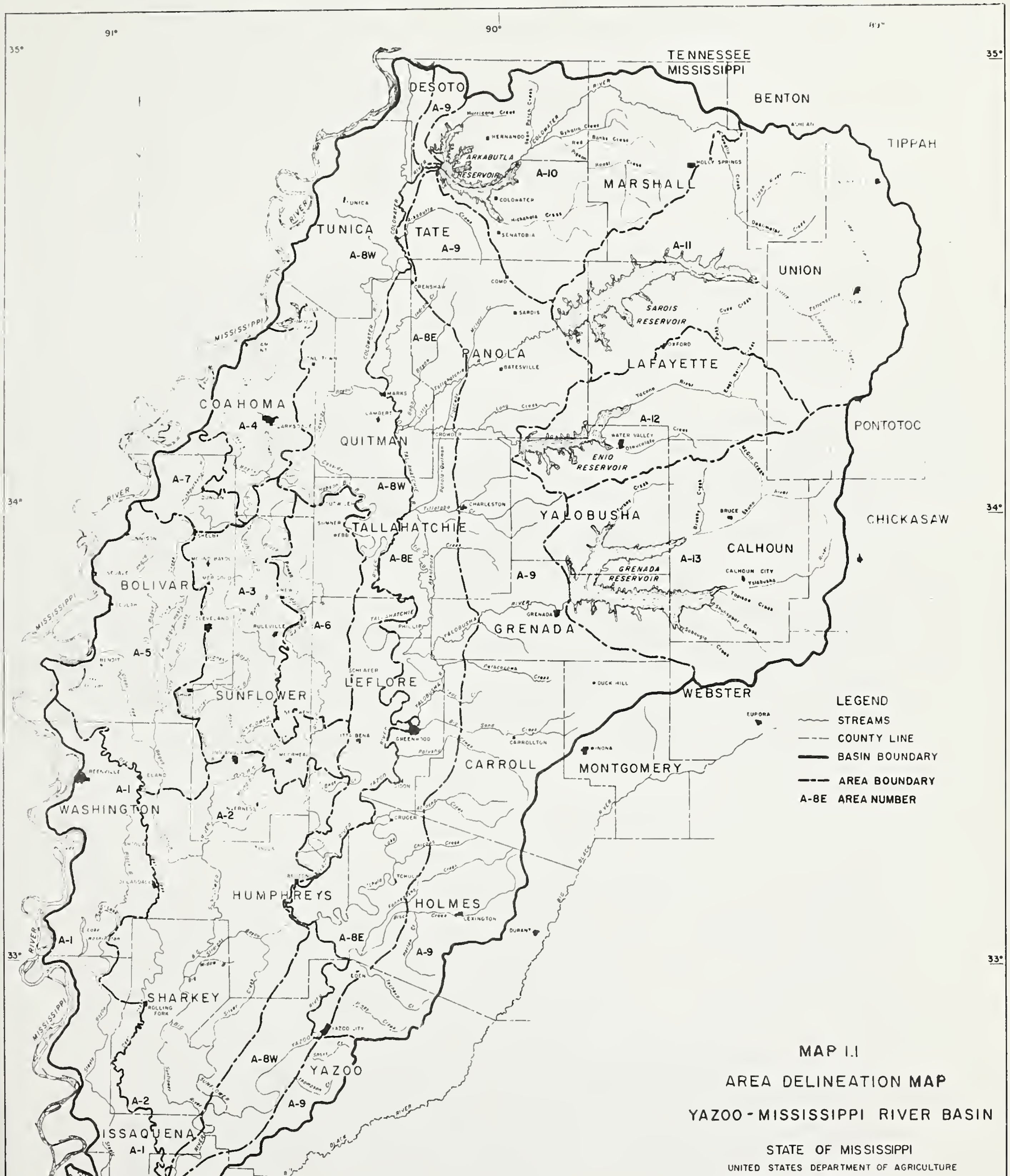
The hill subarea consists of areas 10 through 13. The Little Tallahatchie River Watershed, a flood prevention project, is the same as area 11.

Table 1.1 provides data on most sub-divisions used in this study. Additional delineations of areas were made for some other specific purposes when deemed appropriate for more meaningful data appraisal. This is exemplified in Chapter IV for water withdrawal requirements for such needs as municipal, industrial, and other specific needs.

Table 1.1. Identification of areas, subareas, and other sub-divisions, Yazoo-Mississippi River Basin

Areas and/or subareas	Area(s) included
	Number
Subarea	
Yazoo-Delta	1, 2, 3, 4, 5, 6, 7, 8W, 8E
Yazoo-Bluff	9
Yazoo-Hill	10, 11, 12, 13
Flood Prevention Projects	
Yazoo River Watershed	8E, 9 except below Yazoo City, 10, 12, 13
Little Tallahatchie River Watershed	11
PL-566 area	
Delta	1, 2, 3, 4, 5, 6, 7, 8W
Bluff	9, below Yazoo City
PL-534 area	
Delta	8E
Bluff	9, except below Yazoo City
Hill	10, 11, 12, 13

Source: River Basin Survey Staff, United States Department of Agriculture.



MAP 1.1
AREA DELINEATION MAP
YAZOO - MISSISSIPPI RIVER BASIN
STATE OF MISSISSIPPI
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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CHAPTER II

NATURAL RESOURCES OF THE BASIN

Location

The Yazoo-Mississippi River Basin consists of the entire drainage area of the Yazoo River and lies totally within the State of Mississippi. The basin is composed of 13,355 square miles, or 13 percent of the total area of the Lower Mississippi Water Resource Region.

The western boundary of the basin is formed by the east bank Mississippi River levee from about Memphis, Tennessee, to the vicinity of Vicksburg, Mississippi, where the boundary becomes the east top bank of the Mississippi River. The basin is bordered on the north by the divides of the Wolf and Hatchie River Basins. The eastern and southern boundaries are formed by the divides of the Tombigbee and Big Black River Basins, respectively.

The basin is about 200 miles in length with a maximum width of about 110 miles. No drainage enters from other basins. With the exception of McKinny Bayou, all the drainage which originates from within eventually passes through the mainstem of the Coldwater, Tallahatchie and the Yazoo River system to the Mississippi River.

The basin includes all or part of 30 counties. The land area of each county is shown in table 2.1.

Climate

The climate of the Yazoo-Mississippi River Basin is basically a humid, subtropical climate with abundant precipitation, generally influenced by the Gulf of Mexico to the south and the huge land mass to the north. Warm temperatures can be expected to begin in May and continue into September. The remainder of the year is generally mild with freezing or sub-freezing temperatures occurring but seldom lasting more than three or four days at a time.

In the spring and summer months, the prevailing winds are from the south or southwest, providing warm, moist air conducive to local afternoon thundershowers. Occasionally, during periods of the summer and fall, westerly or northerly winds bring drier weather. During the winter months, the prevailing winds are from the north and northwest.

Table 2.1. County land area in the Yazoo-Mississippi River Basin, 1970

County	County land area in basin Acres
Benton	138,900
Bolivar	516,600
Calhoun	378,900
Carroll	306,800
Chickasaw	79,800
Coahoma	298,900
DeSoto	231,700
Grenada	276,100
Holmes	355,400
Humphreys	262,400
Issaquena	223,600
Lafayette	387,800
Leflore	376,300
Marshall	398,500
Montgomery	91,400
Panola	438,400
Pontotoc	189,200
Quitman	263,700
Sharkey	279,000
Sunflower	443,500
Tallahatchie	412,100
Tate	245,100
Tippah	91,800
Tunica	238,600
Union	213,400
Warren	118,200
Washington	426,800
Webster	81,400
Yalobusha	315,500
Yazoo	377,200
Total	8,457,000 1/

Source: Mississippi Soil and Water Conservation Needs Inventory - 1967, Conservation Needs Committee, Jackson, Mississippi.

1/ Includes ponds and lakes less than 40 acres in size and streams less than 1/8 mile wide, commonly referred to as small water. Excludes 90,000 acres of large water (lakes and reservoirs that exceed 40 acres in size and streams greater than 1/8 mile wide).

Rainfall varies over the Yazoo-Mississippi River Basin from an average of about 49.5 inches in the extreme lower reaches up to about 54.5 inches average in the extreme northeastern portion of the basin. Overall, an average rainfall of 52 inches falls annually on the basin. The average monthly rainfall varies from a low of 2.5 inches in October to a high of 6.0 inches in January. The greatest amount of rainfall normally occurs during the months of December to April while the least amount normally occurs during September and October. The most severe storms in terms of total volume of rainfall generally occur during the winter season. However, the severe weather conditions can occur at any time during the year. The most intense rainfall in terms of inches per hour occurs during local summer thunderstorms and can produce intense runoff and cause severe flood damage locally.

The average annual temperature ranges from 65.9° F. at Vicksburg in the lower section up to about 60.4° F. at Holly Springs in the upper section of the basin with a basin-wide average of about 64° F. Average monthly temperatures vary from 47° F. in January to 82° F. in July. Observed temperature extremes in the area range from minus 16° F. to 115° F. The growing seasons average about 250 days at the extreme southern part of the basin to approximately 215 days in the extreme northern part. Basin-wide, the average annual growing season is about 230 days.

Table 2.2 shows data relative to rainfall, temperature, and frostfree growing season information at selected representative stations for comparison of the averages, extremes, and variations throughout the Yazoo-Mississippi River Basin.

In general summary, the Yazoo-Mississippi River Basin may be described as having little severe cold in the winter, little extreme heat in the summer, short-duration cold spells, relatively long growing seasons, ample rainfall, an abundance of sunshine, and with the drier season occurring most frequently at harvest time.

Physiography and Geology

The basin is separable into five distinct physiographic districts. These districts cross the basin in north-south trending zones or belts. From west to east, and from most recent to oldest, they are as follows: Mississippi Alluvial Plain, Loess or Bluff Hills, North Central Hills, Flatwoods, and Pontotoc Ridge (see table 2.3 and map 2.1.)

The Mississippi Alluvial Plain, or "Delta" as it is locally called, is the most distinctive landform in the state. The topography as the name suggests is that of a flat plain. The surface is

Table 2.2. Precipitation, temperature, and growing season data, Yazoo-Mississippi River Basin

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Stoneville 1/													
Min. Rain	1.44	0.91	0.64	2.03	0.73	0.66	0.39	0.12	0.43	0.10	0.30	1.00	35.29
Ave. Rain	4.83	5.12	5.72	5.02	4.64	3.57	4.34	2.48	3.17	2.44	4.94	5.08	51.37
Max. Rain	11.68	11.07	13.91	11.66	11.30	11.45	9.95	7.05	15.59	7.84	11.34	11.86	73.55
Min. Temp.	36.3°	40.1°	43.1°	60.2°	67.0°	75.6°	78.4°	77.2°	70.9°	57.6°	49.1°	35.4°	61.6°
Ave. Temp.	44.0°	47.0°	54.3°	64.5°	72.1°	79.4°	81.5°	80.5°	75.1°	64.9°	53.8°	46.3°	63.6°
Max. Temp.	55.4°	54.7°	63.6°	68.5°	75.8°	84.0°	84.6°	84.1°	79.6°	70.4°	58.6°	53.5°	65.7°
32° Frost - Last of spring: Earliest 3-6; Average 3-20; Latest 4-21. First of fall: Earliest 10-17; Average 11-4; Latest 11-23. Average growing season: 229 days. Longest 262 days. Shortest 192 days.													
Greenwood 1/													
Min. Rain	1.28	1.21	1.06	1.46	0.82	0.04	1.34	0.50	0.16	0.63	0.11	0.97	32.31
Ave. Rain	5.45	5.09	6.05	5.34	4.26	3.45	4.78	3.05	2.95	2.52	4.62	5.29	52.84
Max. Rain	12.12	10.42	16.84	10.91	8.34	11.19	11.12	7.69	19.65	10.22	15.43	11.13	74.07
Min. Temp.	36.8°	39.3°	45.1°	59.9°	67.3°	76.0°	78.0°	75.9°	69.9°	56.1°	48.8°	35.8°	62.1°
Ave. Temp.	44.8°	47.8°	54.9°	64.9°	72.5°	79.7°	81.9°	81.0°	75.5°	65.1°	53.8°	46.8°	64.1°
Max. Temp.	55.5°	55.0°	62.9°	68.8°	76.8°	85.7°	85.5°	85.9°	80.3°	71.1°	59.6°	56.6°	65.7°
32° Frost - Last of spring: Earliest 2-23; Average 3-17; Latest 3-29. First of fall: Earliest 10-17; Average 11-3; Latest 11-29. Average growing season: 231 days. Longest 268 days. Shortest 210 days.													
Yazoo City 1/													
Min. Rain	1.65	1.94	1.71	1.01	0.36	0.17	0.72	0.64	0.06	0.15	1.23	0.90	35.51
Ave. Rain	5.35	5.61	5.77	5.25	4.57	3.76	4.66	3.22	2.84	2.72	4.54	5.70	53.83
Max. Rain	11.77	13.31	11.20	10.85	11.47	9.39	10.38	8.28	8.21	11.11	13.86	14.29	69.73
Min. Temp.	38.2°	40.4°	45.7°	60.2°	69.9°	74.9°	78.2°	77.5°	71.3°	60.5°	48.7°	37.5°	62.0°
Ave. Temp.	45.8°	48.2°	55.8°	65.3°	72.5°	79.5°	81.6°	81.0°	76.1°	65.8°	54.7°	48.0°	64.4°
Max. Temp.	58.7°	55.9°	63.6°	70.5°	76.2°	84.1°	85.4°	86.5°	80.7°	71.4°	61.4°	57.8°	66.2°
32° Frost - Last of spring: Earliest 2-23; Average 3-21; Latest 4-16. First of fall: Earliest 10-8; Average 11-4; Latest 11-23. Average growing season: 229 days. Longest 262 days. Shortest 193 days.													
Vicksburg 1/													
Min. Rain	1.58	1.41	0.62	1.03	0.48	0.23	0.61	0.35	0.11	0.03	0.04	1.45	34.15
Ave. Rain	5.16	5.45	5.71	5.54	4.39	3.25	3.67	3.14	3.02	2.46	4.15	5.87	51.71
Max. Rain	12.91	13.69	15.42	12.73	10.00	9.79	8.95	16.58	9.93	12.85	16.28	14.33	68.02
Min. Temp.	40.0°	42.1°	47.9°	61.4°	68.2°	75.1°	78.4°	77.9°	72.3°	60.5°	50.8°	44.7°	63.7°
Ave. Temp.	47.6°	50.3°	57.1°	66.1°	72.7°	79.2°	81.4°	80.9°	76.2°	66.9°	56.3°	49.8°	63.1°
Max. Temp.	58.7°	57.8°	64.5°	70.3°	75.6°	83.7°	84.2°	85.5°	81.0°	71.9°	62.9°	57.3°	67.2°
32° Frost - Last of spring: Earliest 1-24; Average 3-10; Latest 4-8. First of fall: Earliest 10-18; Average 11-15; Latest 12-23. Average growing season: 250 days. Longest 296 days. Shortest 214 days.													

continued --

Table 2.2. Precipitation, temperature, and growing season data, Yazoo-Mississippi River Basin (continued)

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Holly Springs 1/													
Min. Rain	1.36	1.05	1.38	2.05	1.31	0.03	1.25	0.17	0.16	0.45	0.48	1.68	38.97
Ave. Rain	5.68	5.53	5.63	5.42	5.15	3.47	4.70	3.48	3.52	2.82	5.15	5.16	55.70
Max. Rain	12.84	11.04	12.86	10.36	15.32	8.99	11.11	8.13	8.52	7.18	13.90	10.01	70.21
Min. Temp.	31.8°	34.5°	39.6°	56.7°	62.6°	72.6°	74.6°	72.4°	66.6°	55.5°	45.4°	30.5°	58.1°
Ave. Temp.	40.2°	42.8°	50.3°	61.3°	68.6°	76.2°	79.2°	78.2°	72.3°	61.9°	50.4°	42.5°	60.4°
Max. Temp.	52.2°	51.5°	60.9°	66.6°	74.1°	83.4°	84.5°	84.6°	78.1°	68.4°	56.3°	51.5°	63.5°
32° Frost - Last of spring: Earliest 3-19; Average 3-29; Latest 4-19. First of fall: Earliest 10-6; Average 11-4; Latest 11-9. Average growing season: 219 days. Longest 229 days. Shortest 179 days.													
Clarksdale 1/													
Min. Rain	0.79	0.88	0.56	1.47	0.59	0.21	1.17	0.30	0.02	0.27	0.56	1.31	30.04
Ave. Rain	5.16	5.14	5.54	5.29	4.77	3.11	4.17	2.43	3.16	2.36	4.80	4.99	50.62
Max. Rain	13.81	10.74	12.43	11.01	14.27	6.94	10.21	5.81	8.74	7.56	12.57	9.64	73.40
Min. Temp.	34.6°	37.9°	41.7°	60.0°	67.9°	76.1°	79.1°	76.9°	71.1°	59.5°	48.2°	34.8°	61.2°
Ave. Temp.	42.8°	46.0°	53.4°	64.5°	72.7°	80.2°	82.6°	81.5°	75.7°	65.6°	53.2°	45.2°	63.6°
Max. Temp.	53.7°	54.7°	63.6°	69.4°	78.1°	88.0°	86.4°	86.4°	79.9°	72.6°	57.8°	53.3°	66.4°
32° Frost - Last of spring: Earliest 2-11; Average 3-18; Latest 4-14. First of fall: Earliest 10-18; Average 11-9; Latest 11-30. Average growing season: 236 days. Longest 271 days. Shortest 197 days.													
University 1/													
Min. Rain	1.15	0.93	1.36	1.41	2.04	0.36	0.52	0.39	0.10	0.66	0.71	0.84	37.97
Ave. Rain	5.70	5.38	6.00	5.81	4.82	3.66	4.09	3.06	3.78	2.70	5.48	4.88	55.58
Max. Rain	12.01	12.31	16.07	10.61	9.79	8.44	11.76	6.65	10.02	7.72	14.72	11.20	73.86
Min. Temp.	33.7°	34.9°	42.2°	57.3°	63.0°	72.9°	75.0°	73.1°	67.5°	57.1°	46.7°	32.0°	58.2°
Ave. Temp.	41.5°	44.5°	51.9°	62.6°	69.3°	76.9°	79.7°	78.8°	73.5°	62.9°	51.4°	43.9°	61.4°
Max. Temp.	54.5°	53.5°	62.4°	67.8°	74.0°	83.5°	84.3°	85.9°	80.7°	71.0°	58.2°	52.8°	65.0°
32° Frost - Last of spring: Earliest 3-13; Average 3-28; Latest 4-19. First of fall: Earliest 9-29; Average 11-7; Latest 11-10. Average growing season: 224 days. Longest 229 days. Shortest 179 days.													
Calhoun City 2/													
Min. Rain	1.40	1.10	1.65	1.70	0.90	0.30	1.45	0.20	0.50	0.33	0.40	1.55	29.65
Ave. Rain	5.39	5.35	6.10	5.51	3.66	3.34	4.43	2.67	2.99	2.51	4.38	5.28	51.15
Max. Rain	13.10	12.21	14.39	14.45	7.30	12.80	11.45	7.35	8.50	7.41	14.25	12.20	71.80
Min. Temp.	38.1°	38.5°	43.6°	58.7°	66.5°	71.6°	77.2°	75.3°	69.5°	59.2°	48.5°	35.5°	60.6°
Ave. Temp.	42.3°	46.0°	53.0°	63.5°	70.4°	76.7°	79.9°	79.0°	74.0°	63.0°	52.5°	45.7°	62.1°
Max. Temp.	47.8°	54.3°	58.9°	67.7°	73.9°	79.1°	82.5°	80.3°	77.5°	67.9°	58.1°	52.8°	63.5°
32° Frost - Last of spring: Earliest 3-18; Average 3-31; Latest 4-16. First of fall: Earliest 10-11; Average 10-29; Latest 11-16. Average growing season: 215 days. Longest 224 days. Shortest 184 days.													

Source: National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

1/ Temperature and precipitation records, 1945-1973.

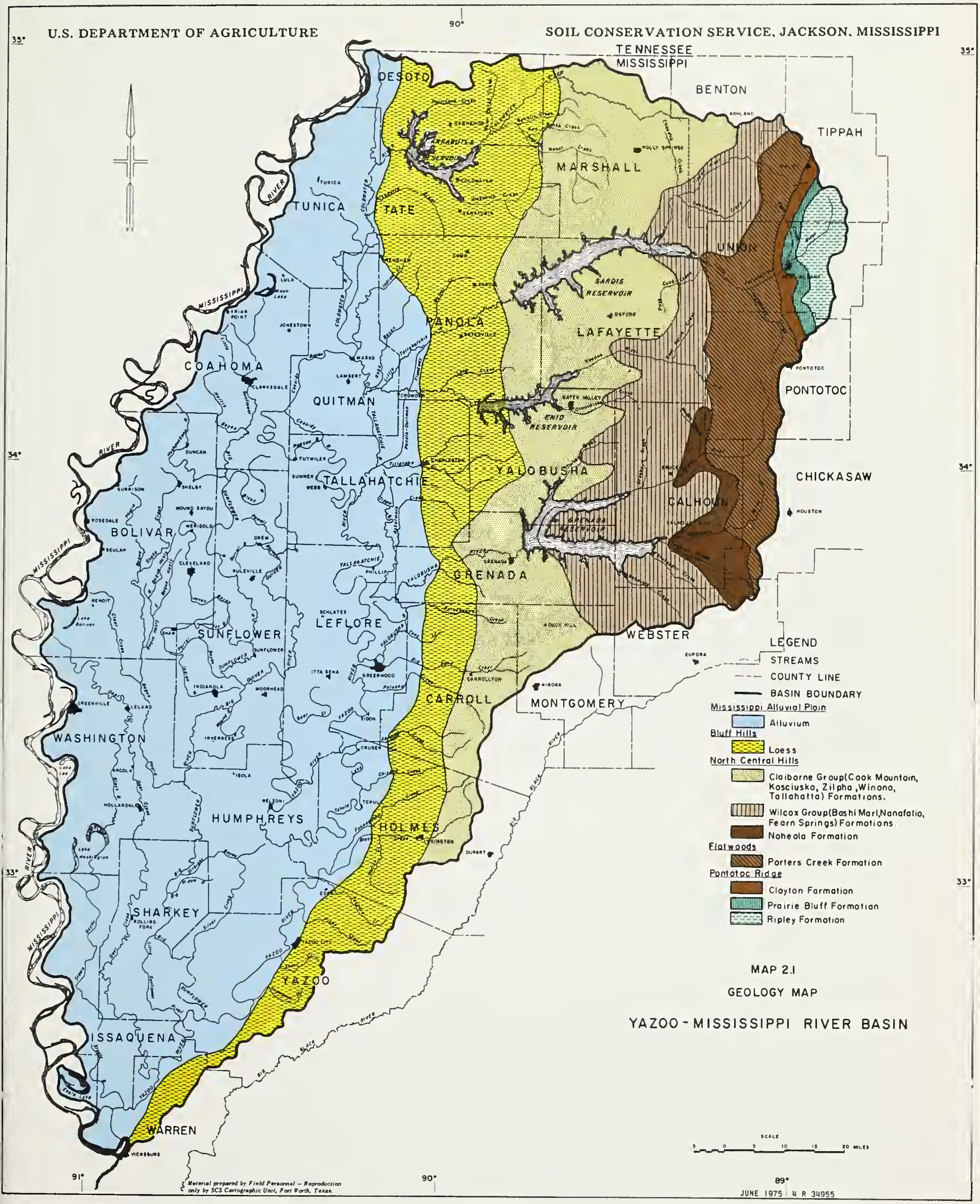
2/ Temperature records 1955-1973 and precipitation records 1948-1973.

Table 2.3. Geologic characteristics, Yazoo-Mississippi River Basin

MAJOR LAND RESOURCE AREA	PHYSIOGRAPHIC DISTRICT	GEOLOGIC FORMATION	GROUP	SERIES	SYSTEM	ERA
Southern Mississippi Valley Alluvium - 131 -	Mississippi Alluvial Plain	Alluvium		Holocene	Quarternary	Cenozoic
Southern Mississippi Valley Silty Uplands - 134 -	Loess or Bluff Hills	Loess		Pleistocene		
	North Central Hills	Cook Mountain Sparta (Kosciusko) Zilpha Winona Tallahatta	Claiborne	Eocene	Tertiary	
		Bashi Marl Nanafalia Fearn Springs	Wilcox			
Southern Coastal Plain - 133 -		Naheola	Midway	Paleocene		
	Flatwoods	Porters Creek				
	Pontotoc Ridge	Clayton				
		Prairie Bluff	Selma	Gulf or Upper Cretaceous	Cretaceous	Mesozoic
		Ripley				

Older - Most Recent

Source: Soil Conservation Service, United States Department of Agriculture.



USDA-SCS-FORT WORTH, TEX. 1975

characterized by very slight undulations of the "swell and swale" type. The slightly higher, better drained areas along the courses of the major streams have built up gently sloping natural levees. The interstream areas, on the other hand, are lower, poorly drained swales. The topography is further modified by extremely sinuous, shifting courses of streams and by the presence of numerous oxbow or crescent-shaped lakes. These lakes are remnants of changes in stream courses and they lie in the deeper portions of the older channels.

The Loess or Bluff Hills comprise a narrow belt, 15 to 25 miles in width, bordering the eastern edge of the Mississippi Alluvial Plain from Tennessee on the north to Louisiana on the south. Throughout this strip, the surface is characterized by hills with steep slopes, narrow ridges, and narrow intervening valleys. These hills are bounded on the west by an abrupt escarpment which leads to the level bottomlands of the alluvial plain. The depth of the loess decreases toward the east near the western margin of the North Central Hills. Here the depth is but a few feet deep and the vertical stream valley walls are not present. The interstream sections of this zone are rolling to moderately hilly uplands.

The North Central Hills region is a large, wide belt of sands and clays. This extensive district is an upland area that has been cut into hills and valleys by stream erosion. Stream action, with considerable ease and consistency, has cut deep valleys through the region, in the unconsolidated sands and clays of the Wilcox and Claiborne Formations, thereby changing the once level plateau into an area of rough and rugged relief. In a few scattered areas, the rather broad level remnants of the plateau surface remain, and along many of the large streams, broad flood plains are to be found; but by and large, the region is one of sharply inclined surfaces that are subject to rapid sheet erosion and gullying.

The Flatwoods form a long, narrow belt of low relief which marks the outcrop of the Porters Creek clay. In general, the area is a gently undulating to somewhat rolling wooded plain underlain by dense, impervious clays. Its principal distinctive topographic feature is the lack of relief, the broad stream valleys being separated by slight swells.

The Pontotoc Ridge coincides in its geographic distribution with the outcrop of the Ripley and Clayton Formations. Relief of the surface hills range from 40 to 50 feet, with gentle slopes and broadly rounded crests, which prevail along the western side of the area, to those of sharp outline and a relief of as much as 250 feet, with steep slopes, narrow ridges, and narrow intervening valleys, which prevail along the eastern side of the area. These hills form the divide between the Tombigbee drainage system on the east and the streams that flow to the Mississippi River on the west.

The outcrop or surface exposure of the formations that make up the above physiographic districts form north-south trending zones. The dip of the formations is to the west and southwest, the older formations being under the younger ones.

The Loess (Bluff silt) Formation consists of buff to tan, yellow, red, or gray, massive, sandy to clayey silts. Thickness varies from a few feet to 200 feet in depth. The Mississippi Loess is believed to be of a glacial-fluvial-eolian origin, but there has been much controversy over this subject.

The Cook Mountain Formation, formerly called Wautubbee Formation, is composed of Shipps Creek Shale Member, Archusa Marl Member, Potterchitto Member, and Gordon Creek Shale Member. Thickness ranges from 0 to about 325 feet.

The Kosciusko Formation consists of a basal portion of iron-stained, slightly lignitic, highly cross-bedded sands and clay pellets. Above the basal sand are gray to brown carbonaceous, lignitic silts and clays. At the Zilpha-Kosciusko contact, meta-sedimentary light gray quartzite is found. Thickness of the Kosciusko ranges from 85 to 400 feet.

The Zilpha Formation is composed of a basal unit, the Zana Member, and two upper units. The upper thin unit is green sand, the middle, and main unit consists of chocolate-brown to gray, carbonaceous silty, shaly, cross-bedded clay with stringers and lenses of micaceous sand. The lower unit (Zana) is composed of glauconitic sand. Thickness of the Zilpha Formation averages from 15 to 25 feet.

The Winona Formation consists of interbedded, pale-gray, glauconitic, silty chalks and sandy marls with minor amounts of light-gray and greenish-gray fossiliferous, slightly calcareous clay and clay shales. Thickness averages 25 feet.

The Tallahatta Formation is composed of, in ascending order, the Meridian Sand Member, the Basic City Shale Member, and the Neshoba Sand Member and is the basal unit of the Claiborne Group. Thickness ranges from 10 to 570 feet.

The Bashi Marl Formation, formerly called Woods Bluff Group, is composed of a gray glauconitic, fossiliferous, calcareous, sandy marl with some lignite. Thickness is approximately 25 feet.

The Nanafalia Formation consists of buff-colored, fossiliferous, glauconitic, calcareous sands, dark, lignitic silt and clays and some gravels. Thickness is approximately 150 feet.

The Fearn Springs Formation is the basal unit of the Wilcox Group. It is composed of purplish, silty sands and clays and some lignite. Thickness is about 50 feet.

The Naheola Formation is both the uppermost unit of the Paleocene and of the Midway Group. It consists of non-marine, alternating beds of sand, silt, and clay with some lignite and marl. Thickness is approximately 1,600 feet.

The Porters Creek Formation is composed of a dark-gray to black, pyritiferous, montmorillonitic, partially silty and sandy clay with local siderite concretions and, upon weathering, is a gray to brown-gray blocky clay. Also included in the Porters Creek are the Tippah Sand Member and the Matthews Landing Marl Member. Thickness at type locality is 80 feet. In Mississippi, thickness at outcrop varies from about 250 to 475 feet, and in the subsurface it reaches approximately 1,100 feet.

The Clayton Formation is the lower unit of the Midway Group of the Paleocene. It consists of pale-gray and light-gray, argillaceous, slightly bentonitic chalks, gray fossiliferous limestone, and gray to dark-gray shales. The unit underlies and interfingers with the Porters Creek clay and unconformably overlies Cretaceous sediments. Thickness is usually less than 50 feet.

The Prairie Bluff Formation (and Owl Creek Formation) is the uppermost formation of the Selma group. It is composed chiefly of bluish-gray, fossiliferous, glauconitic, massive, sandy chalk. Marcasite and pyrite concretions, phosphatic nodules, and calcareous concretions and nodules are common. Thickness varies from 12 to 70 feet and interfingers with the Owl Creek Formation.

The Ripley Formation is composed of the Coon Creek, McNairy Sand, and Chiwapa Sandstone Members, and a transitional clay unit. Thickness varies from 20 to 460 feet. The Coon Creek Member consists of blue to dark-gray, fossiliferous marl, subordinate beds of clay and some thin beds of sandstone. The McNairy Sand Member consists of gray to vari-colored, micaceous sands with bands of furruginous, indurated sandstones and subordinate clays. The Chiwapa Sandstone Member consists of calcareous, fossiliferous, indurated, rarely bentonitic sands and sandstones and limestone and grades laterally toward the south into the McNairy Sand.

Major Land Resource Areas and Soils

The land resource area (LRA) determination is a physical grouping based on a combination of factors such as pattern of soils, topography, type of agriculture, and others. The grouping is made for

the purpose of broad agricultural interpretations. There are three major land resource areas within the basin (map 2.2). They are the Southern Mississippi Valley Alluvium (LRA 131), the Southern Mississippi Valley Silty Uplands (LRA 134), and the Southern Coastal Plain (LRA 133).

The Southern Mississippi Valley Alluvium (LRA 131) comprises 51 percent of the basin. The area consists of nearly level to gently sloping broad flood plains and low terraces. Most of the area is flat. The only noticeable slopes are terrace scarps and natural levees that rise sharply a few feet to several tens of feet above adjacent bottomlands or stream channels.

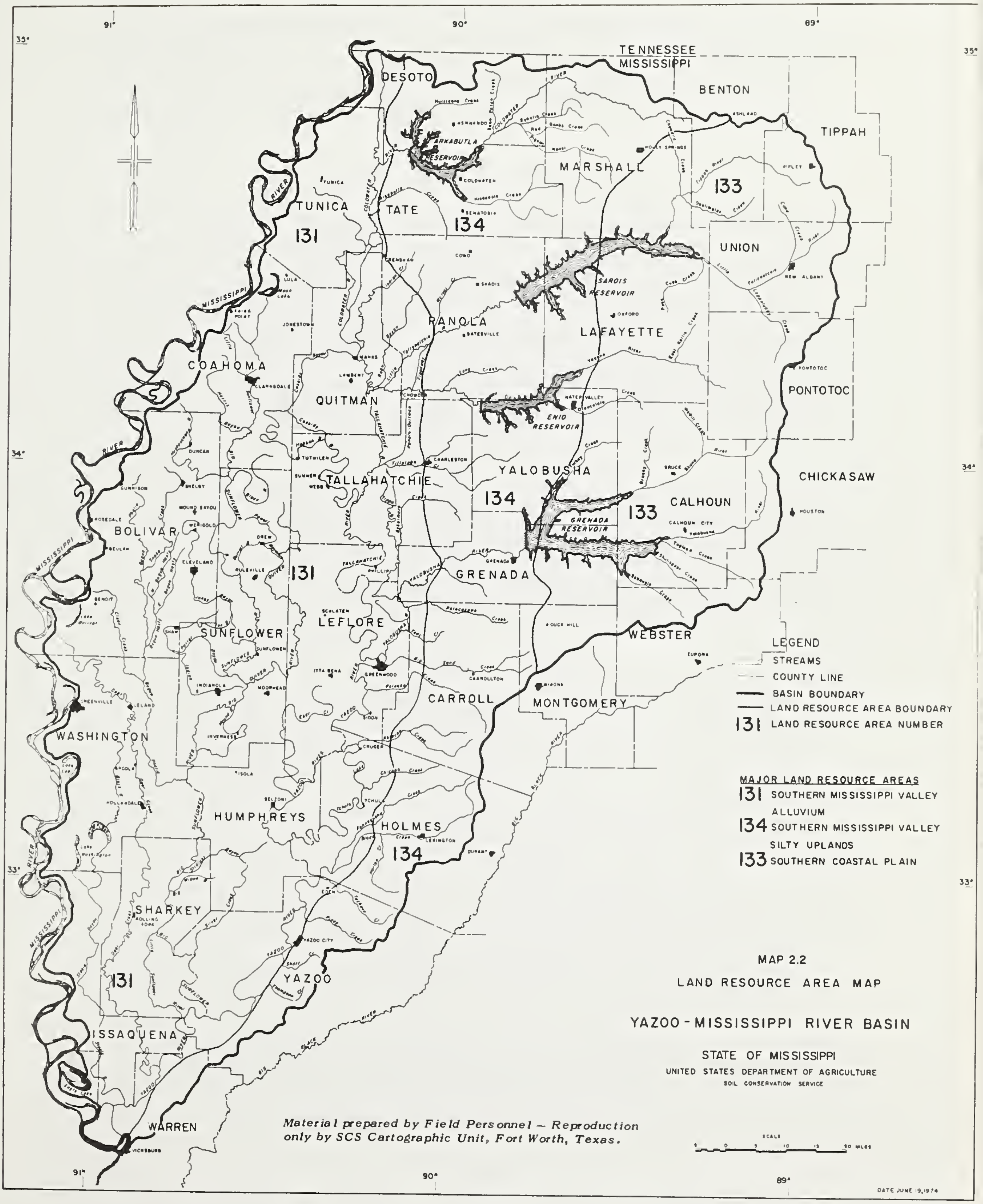
Alligator, Tunica, and Sharkey (Aquepts) are poorly drained, clayey soils located on flood plains. Commerce, Convent, and Mhoon (Aquents), and Morganfield, Robinsonville, (Fluvents), and Bruin (Ochrepts) are silty and loamy soils also on flood plains. Bosket, Dubbs, and Tutwiler (Udalfs) are well drained and located on higher terraces. Low terrace soils include Amagon, Dundee, Forestdale, and Tensas (Aqualfs).

The Mississippi Valley Silty Upland (LRA 134) comprises 28 percent of the basin. The sharply dissected plains have a thick loess mantle, which is underlain by unconsolidated sands, silt, and clays, mainly of marine origin. Valley sides are hilly to steep especially in the west. The intervening ridges are mostly narrow and rolling, but some of the interfluves between the upper reaches are broad and flat. Stream valleys are narrow in their upper reaches but broaden rapidly downstream and have wide flat flood plains and meandering stream channels. Local relief ranges from several tens of feet to 100 or 200 feet.

The predominant soils of LRA 134 include Bude, Calloway, Grenada, Lexington, Loring, Memphis, and Providence (Udalfs). These are upland soils formed in silty materials. All except Lexington and Memphis have fragipans. Bonn, (Aqualfs) has silty subsoils that are high in sodium. Adler, Collins, Morganfield, and Vicksburg (Fluvents) are silty soils located on flood plains. Falaya, Gillsburg, and Waverly (Aquents) are somewhat poorly and poorly drained silty soils on flood plains.

The Southern Coastal Plain (LRA 133) comprises 21 percent of the basin. The gently to strongly sloping dissected coastal plain is underlain by unconsolidated sands, silts, and clays.

A variety of soils comprise LRA 133. Ruston, Saffell, and Smithdale (Udults) are well drained, loamy upland soils. Eustis (Udults) soils are sandy, Shubuta, and Sweatman soils (Udults) have clayey subsoils. Ora and Savannah (Udults) have fragipans. Boswell,


TENNESSEE
MISSISSIPPI
DESOTO
BENTON
TIPPAH
MARSHALL
TUNICA
TATE
UNION
COAHOMA
PANOLA
LAFAYETTE
QUITMAN
PONTOTOC
YALOBUSHA
TALLAHATCHIE
CHICKASAW
CALHOUN
BOLIVAR
GRENADA
LEFLORE
SUNFLOWER
WEBSTER
CARROLL
MONTGOMERY
WASHINGTON
HUMPHREYS
HOLMES
SHARKEY
YAZOO
ISSAQUENA
WARREN
ARKABUTLA RESERVOIR
SARDIS RESERVOIR
ENID RESERVOIR
GRENADA RESERVOIR
131
133
134
LEGEND
STREAMS
COUNTY LINE
BASIN BOUNDARY
LAND RESOURCE AREA BOUNDARY
131 LAND RESOURCE AREA NUMBER
MAJOR LAND RESOURCE AREAS
131 SOUTHERN MISSISSIPPI VALLEY ALLUVIUM
134 SOUTHERN MISSISSIPPI VALLEY SILTY UPLANDS
133 SOUTHERN COASTAL PLAIN
MAP 2.2
LAND RESOURCE AREA MAP
YAZOO-MISSISSIPPI RIVER BASIN
STATE OF MISSISSIPPI
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Material prepared by Field Personnel – Reproduction only by SCS Cartographic Unit, Fort Worth, Texas.
DATE JUNE 19, 1974

Cadeville, and Susquehanna (Udalfs) have thick clayey subsoils. Myatt (Aquults) are poorly drained loamy soils. Bibb and Mantachie soils (Aquents) are poorly and somewhat poorly drained soils on flood plains. Other flood plain soils include Iuka, Ochlockonee (Fluvents), and Jena (Ochrepts).

Topography and Drainage System

The physical characteristics of the basin divide it into two distinct areas, referred to in this description as the delta and upland sections. The delta section lies in the alluvial valley of the Mississippi River and occupies the western half of the basin. The terrain of this section is relatively flat with an average slope from north to south of 0.5 foot per mile. The upland section lies in the eastern half of the basin and has topography varying from gently rolling to rugged hills. Elevations in this section range from 100 feet mean sea level near Yazoo City, Mississippi, to over 600 feet on the highest hills in the northeast corner of the basin.

The basin area consists almost entirely of the drainage basin of the Yazoo-Tallahatchie-Coldwater Rivers system and its tributaries, the remaining consisting of small areas draining directly into the Mississippi River in the vicinity of Vicksburg, Mississippi. The principal drainage areas are the Coldwater River, the Tallahatchie River, the Yalobusha River, the Big Sunflower River-Steele Bayou, and the Yazoo River.

The drainage area of the Coldwater River and its tributaries covers an area of about 1,980 square miles. The Coldwater River rises in the hills of Marshall County, Mississippi, and is joined by Hickahala and Pigeon Roost Creeks and smaller streams before flowing into Arkabutla Lake. Leaving the lake, Coldwater River enters the delta section where it is joined by flowage from the Lake Cormorant area, Arkabutla Canal, and other smaller streams. In the vicinity of Crenshaw, Mississippi, the flow of the Coldwater River is diverted through Pompey Ditch. The remaining channel of Coldwater River collects discharges of Whiteoak Bayou and other northwestern delta streams before rejoining Pompey Ditch north of Marks, Mississippi. Here the stream is joined by David and Burrell Bayous. In the vicinity of Lambert, Mississippi, the Coldwater River is joined by the channel of Old Little Tallahatchie River. At this point, Coldwater River becomes Tallahatchie River.

The Tallahatchie River drainage area encompasses 3,420 square miles, of which 2,650 square miles lie in the hill section. The remaining 770 square miles are drained by tributaries in the delta section. The principal hill tributaries are the Little Tallahatchie

and Yocona Rivers, which originate in Tippah and Pontotoc Counties, respectively. The Little Tallahatchie River is joined by Tippah River and smaller tributaries before discharging into Sardis Lake. Below the lake the Little Tallahatchie River is routed through the Panola-Quitman Floodway, which also collects flow from Yocona River before entering the Tallahatchie River west of Charleston, Mississippi. The Yocana River, joined by Otoucalofa Creek and smaller tributaries, enter Enid Lake in northern Yalobusha County, Mississippi. Downstream of the lake, Yocona River enters the Panola-Quitman Floodway near Crowder, Mississippi. The principal delta tributaries of Tallahatchie River are Cassidy, Oppossum, and Hurricane Bayous. Tillatoba Creek, a hill tributary, enters Tallahatchie River at the junction with the Panola-Quitman Floodway. The Tallahatchie River main stem begins at the confluence of the Coldwater River with the channels of Old Little Tallahatchie and Old Yocona Rivers and terminates at Greenwood, Mississippi, where it and the Yalobusha unite to form the Yazoo River.

The Yalobusha River drainage area covers about 2,050 square miles, most of which lies in the hill section of the basin. Yalobusha River rises in Chickasaw County, Mississippi, and flows in a westerly direction. Near Grenada, Mississippi, the Yalobusha and Skuna Rivers merge with smaller streams to form Grenada Lake. Downstream of the lake, Teoc and Potococowa Creeks, Ascalmore Creek-Tippo Bayou, and Batupan Bogue enter the Yalobusha before it combines with Tallahatchie River at Greenwood.

The Big Sunflower River-Steele Bayou covers 4,093 square miles and lies in the delta section of the basin. The Big Sunflower River rises in Coahoma County, Mississippi, and flows southerly for over 200 miles before entering the Yazoo River. The principal tributaries of the Big Sunflower River are the Quiver, Hushpuckena, and Little Sunflower Rivers and Bogue Phalia. The Steele Bayou Basin extends from the northwestern end of Washington County, Mississippi, to the Yazoo River 10 miles north of Vicksburg, Mississippi. The main stem of Steele Bayou is formed at Swan Lake by the junction of flows from Main Canal and Black Bayou. The drainage basins of Big Sunflower River and Steele Bayou are separated by Deer Creek. The Will M. Whittington Auxiliary Channel crosses the southeast section of the Big Sunflower River-Steele Bayou Basin and diverts a major portion of flood flow out of the Yazoo River near Silver City, Mississippi, and passes it down to re-enter the Yazoo River near the mouth of Big Sunflower River.

The Yazoo River drainage basin consists of the main stem Yazoo River from Greenwood to Vicksburg and does not include the drainage basins of upstream tributaries mentioned previously. The basin drains approximately 1,812 square miles which is almost equally divided between delta and hill areas. Yazoo River is formed at

Greenwood by the confluence of the Tallahatchie and Yalobusha Rivers. From Greenwood the river flows 169 miles and joins the Mississippi River at Vicksburg. Tributaries not mentioned in preceding paragraphs include Tchula Lake, Alligator-Catfish Bayou, Bear, Pelucia, Big Sand, Abiaca, Chicopa, Fannegusha, and Black Creeks, and Rocky Bayou.

Water Resources 1/

Surface Water Quantity - Rainfall varies over the Yazoo-Mississippi River Basin from an average of some 49.5 inches annually in the lower southern areas up to an average of approximately 54.5 inches annually in the extreme northeast section of the basin. Overall, the basin-wide average annual rainfall is about 52 inches. This 52-inch average amounts to slightly more than 37.0 million acre-feet per year. A large part of this rainfall is returned to the hydrologic cycle by evapo-transpiration, a small part infiltrates to the ground water reservoirs, and the remainder becomes streamflow.

The majority of the streamflow generated in the basin originates in the tributary subareas in the Yazoo headwater area. Major tributaries are the Yalobusha, Yocona, Little Tallahatchie, and Coldwater Rivers. The sequence of flows discharged from each of these respective streams is controlled by the operation of the Grenada, Enid, Sardis, and Arkabutla Dams. These dams control about 60 percent of the total drainage area of the Yazoo River at Greenwood, Mississippi; hence, daily flows for stations at and above Greenwood are greatly affected by short term changes in release rates at the reservoir. This streamflow in terms of average annual runoff represents the normal surface water resource, or the normal recoverable surface water supply. The average annual discharge of streams originating in the Yazoo-Mississippi River Basin is 17,700 cfs. This discharge is equivalent to slightly more than 1.3 cfs per square mile, and amounts to 35 thousand acre-feet per year or about 31.3 million gallons of water per day. The average annual discharge is equivalent to an average runoff of about 18.0 inches per year from the entire basin.

The geographic and seasonal distribution of the surface runoff and the yearly runoff variability are illustrated by tables 2.4, 2.5, and 2.6, which show average, maximum, and minimum rates of various watersheds. Selected gaging stations that are unaffected by the large flood control reservoirs were used in order to portray the natural or normal runoff.

1/ Adapted from Regional Climatology, Hydrology and Geology, Appendix C, Volume II, Lower Mississippi Region Comprehensive Study.

Table 2.4. Maximum, minimum, and average runoff rates at selected gaging stations unaffected by large flood control reservoirs, Yazoo-Mississippi River Basin, selected years

Gaging station	Drainage area	Watershed			Square mile		
		Average	Maximum	Minimum	Average	Maximum	Minimum
	Sq. mi.	Inches	Inches	Inches	Acre feet	Acre feet	Acre feet
Little Tallahatchie River 1/ at Etta, Miss. (1939-1972) 2/	528.0	20.43	36.51	7.51	1,090	1,947	401
Yocona River 1/ at Oxford, Miss. (1952-1972) 2/	262.0	17.22	30.28	7.22	918	1,615	385
Yalobusha River 1/ at Calhoun City, Miss. (1951-1972) 2/	305.0	15.26	29.01	4.05	814	1,547	216
Skuna River 1/ at Bruce, Miss. (1948-1972) 2/	254.0	17.91	30.81	6.08	955	1,643	324
Sunflower River 3/ at Sunflower, Miss. (1939-1972) 2/	767.0	17.66	37.70	7.78	942	2,011	415

Source: Surface Water Supply of the United States, U. S. Geological Survey.

1/ Hill area gage.

2/ Water years.

3/ Delta area gage.

Table 2.5. Monthly maximum, minimum, and average runoff rates at selected gaging stations unaffected by large flood control reservoirs, Yazoo-Mississippi River Basin, selected years

Rate	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Annual
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Little Tallahatchie River at Etta, Mississippi (1939-1972)1/													
Average	0.21	1.22	1.92	3.01	3.58	3.87	2.90	1.52	0.78	0.72	0.34	0.36	20.43
Maximum	1.17	8.22	8.54	9.01	11.68	8.62	9.06	4.70	6.58	2.87	3.27	4.09	36.51
Minimum	0.02	0.04	0.12	0.14	0.35	0.50	0.59	0.23	0.07	0.08	0.03	0.03	7.51
Yocona River at Oxford, Mississippi (1952-1972)1/													
Average	0.22	0.92	1.87	2.01	2.73	3.09	2.99	1.56	0.64	0.50	0.23	0.46	17.22
Maximum	1.39	9.13	6.75	6.58	5.48	7.30	7.19	5.33	2.70	2.31	1.84	5.28	30.28
Minimum	0.05	0.05	0.17	0.19	0.46	0.42	0.70	0.23	0.10	0.07	0.04	0.03	7.22
Yalobusha River at Calhoun City, Mississippi (1951-1972)1/													
Average	0.12	0.69	1.58	2.10	2.91	3.14	2.87	1.06	0.31	0.30	0.08	0.10	15.26
Maximum	1.44	10.34	8.28	7.91	7.27	6.82	9.79	3.64	1.74	2.83	0.43	1.30	29.01
Minimum	0.00	0.00	0.01	0.04	0.23	0.31	0.17	0.04	0.02	0.01	0.00	0.00	4.05
Skuna River at Bruce, Mississippi (1949-1972)1/													
Average	0.13	0.69	1.75	2.75	3.08	3.84	2.83	1.30	0.51	0.45	0.22	0.33	17.91
Maximum	0.79	8.44	6.05	9.49	7.13	10.75	6.92	3.55	3.12	2.79	2.09	3.93	30.81
Minimum	0.01	0.02	0.05	0.09	0.36	0.27	0.44	0.07	0.03	0.02	0.01	0.01	6.08
Sunflower River at Sunflower, Mississippi (1939-1972)2/													
Average	0.45	0.76	1.51	2.46	2.90	2.80	2.46	1.79	0.80	0.76	0.52	0.45	17.66
Maximum	2.69	5.28	5.94	7.69	7.65	6.10	7.01	9.14	2.67	3.53	2.25	3.41	37.70
Minimum	0.14	0.15	0.17	0.18	0.42	0.38	0.52	0.39	0.22	0.15	0.14	0.15	7.78

Source: Surface Water Supply of the United States, U. S. Geological Survey.

1/ Hill area gage.

2/ Delta area gage.

Table 2.6. Yearly runoffs with tabulations of average, maximum, and minimum runoff for selected gaging stations unaffected by large flood control reservoirs, Yazoo-Mississippi River Basin, 1939-1972

Water year	Little Tallahatchie River at Etta, Miss.1/	Yocona River at Oxford, Miss.1/	Yalobusha River at Calhoun City, Miss.1/	Skuna River at Bruce, Miss.1/	Sunflower River at Sunflower, Miss.2/
	Inches	Inches	Inches	Inches	Inches
1972	11.66	9.63	13.00	10.16	8.62
71	18.28	16.81	23.05	17.22	17.26
1970	31.99	30.02	21.65	21.03	24.64
69	23.75	19.08	18.27	13.57	19.26
68	26.81	22.43	21.29	23.29	20.06
67	15.56	11.40	4.09	6.08	9.58
66	11.86	10.66	7.32	9.31	9.36
65	21.15	13.79	11.65	10.86	16.36
64	23.65	18.35	20.89	22.18	13.43
63	10.32	10.15	7.65	9.84	7.78
62	36.51	30.28	29.01	30.81	22.28
61	21.18	17.08	14.73	18.97	21.46
1960	17.04	15.82	17.30	18.12	12.74
59	12.57	12.39	11.50	15.72	13.97
58	30.20	30.00	27.90	28.73	37.70
57	19.18	19.21	14.01	18.01	14.73
56	14.13	13.94	12.51	15.39	11.52
55	17.99	19.11	12.63	22.69	12.74
54	7.51	7.22	4.05	6.09	8.34
53	19.85	15.72	10.98	16.92	21.10
52	21.92	18.51	7.74	15.42	16.13
51	28.89	-	24.48	27.77	19.87
1950	27.49	-	-	25.87	27.93
49	30.15	-	-	25.78	24.03
48	26.14	-	-	-	22.14
47	23.19	-	-	-	17.61
46	33.04	-	-	-	28.45
45	20.50	-	-	-	22.55
44	18.40	-	-	-	17.62
43	8.24	-	-	-	10.24
42	13.17	-	-	-	14.56
41	11.64	-	-	-	11.69
1940	13.98	-	-	-	16.73
1939	26.70	-	-	-	27.54
Total	694.64	361.60	335.70	429.83	600.62
Average	20.43	17.22	15.26	17.91	17.66
Maximum	36.51	30.28	29.01	30.81	37.70
Minimum	7.51	7.22	4.05	6.08	7.78

Source: Surface Water Supply of the United States, U. S. Geological Survey.

1/ Hill area gage.

2/ Delta area gage.

Withdrawals from surface water sources during 1970 (about 730 cfs) were equivalent to about 4 percent of the mean annual flow generated. This constituted about 55 percent of the basin's total water use of 1,355 cfs, with the remaining 45 percent (625 cfs) coming from ground water sources. Major surface water withdrawals were for purposes of power production (425 cfs) and irrigation (195 cfs) which composed 58 and 27 percent respectively, of the total surface water withdrawn. About 8 percent of the surface water withdrawn was for industrial purposes (58 cfs).

During 1970, major withdrawals of ground water were for the purposes of irrigation (276 cfs), commercial fishing (88 cfs), municipal uses (83 cfs), and industrial uses (76 cfs). All of the water used for municipal water supply was withdrawn from ground water sources. About 590 cfs, or 44 percent of the total surface and ground water withdrawals in the basin, was consumed. The remaining 765 cfs was released and returned to streamflow, thus resulting in a net increase to streamflow of about 35 cfs.

The major consumption of water in the basin was for irrigation of crops. About 340 cfs, or 58 percent of all water consumed, was for this purpose, with an average return to stream flow of about 130 cfs. Commercial fishing industries consumed about 104 cfs with most of the water coming from ground water sources and very little being returned to nearby streams.

The use of water for navigation on the lower Yazoo River occurs only on an intermittent basis because of insufficient depths during low flow periods. Currently, a 9-foot navigation depth from Greenwood, Mississippi, to the river mouth is available about 46 percent of the time, with a controlling depth of 4 to 9 feet existing for the remainder of the time. There are no existing locks and dams on the Yazoo River to provide the required navigation pools; however, releases from the four flood control reservoirs are regulated to aid navigation during low flow periods. Another nonconsumptive use is recreation, which is popular in the basin; hence, most lakes and streams are being used for fishing, boating, and related water sports.

Surface Water Quality - Surface water is generally good for most uses. Because strata underlying the basin are composed of many different materials, the dissolved-solids content of the low-flow surface waters ranges from 14 mg/l in Hurricane Creek near Oxford, Mississippi, to 142 mg/l in Hayes Creek 1/ near Vaiden, Mississippi. A sample of water from a stream draining the Quarternary alluvium contained 0.3 mg/l of fluoride and one from a stream draining the Tallahatta Formation and Winona and Sparta Sands contained 0.4 mg/l.

1/ Outside the hydrologic boundary.

Other water sampled in this part of the basin had a fluoride content of not more than 0.2 mg/l. Except for four samples from Hayes Creek near Vaiden, Mississippi, and Yalobusha River at Calhoun City, Mississippi, no sample had a chloride content greater than 20 mg/l. Samples from most streams had less than 10 mg/l of chloride. Iron concentration ranged from 0 to 0.62 mg/l, with most waters containing less than 0.3 mg/l. The pH of samples ranged from 6.4 to 7.5, but most fell between 6.5 and 7.2.

Water draining from the Quarternary area is the calcium bicarbonate type which is characteristic of most water obtained from these deposits in the Yazoo-Mississippi River Basin. This is as expected, because most of the alluvial material in the basin contains calcium carbonate.

The Cockfield Formation and Sparta Sand of Tertiary age crop out just east of the Mississippi Alluvial plain. Water from these formations had a lower dissolved-solids content and a slightly higher sodium content than does water from the Quarternary alluvium. The calcium, magnesium, and bicarbonate content of the water from these two Tertiary units probably is affected by the loess mantle overlying a large part of the area.

Water from the Winona Sand has a dissolved-solids content of about (130 mg/l), whereas the water from the Cockfield Formation and Sparta Sand has a dissolved-solids content of about 60 mg/l and water from the Quarternary deposits has a dissolved-solids content of 100 mg/l. The higher dissolved-solids content of water from the Winona Sand is principally due to higher concentrations of sodium, sulfate, and chloride.

Analyses of water from streams whose drainage basins are entirely in the Tallahatta Formation indicate that the dissolved-solids content of water discharged by this formation is low; the dissolved-solids content ranges from 14 to 25 mg/l. Water from streams whose drainage systems are in both the Tallahatta Formation and Wilcox Group generally has a dissolved-solids content intermediate between that of water from the Tallahatta Formation and that of water from the Wilcox deposits. The dissolved-solids content of water from streams draining Wilcox deposits ranges from 32 to 56 mg/l.

Water from streams draining the Porters Creek clay and Wilcox is similar in chemical composition to waters from streams draining only Wilcox deposits; however, samples collected from the Yalobusha River at Calhoun City, Mississippi, and Skuna River at Bruce, Mississippi, which drain Wilcox deposits, contained greater concentrations of sodium, sulfate, and chloride.

Chiwapa Creek[1] drains the Clayton Formation, Prairie Bluff chalk, and Ripley Formation. Water sampled from this stream has a dissolved-solids content of about 125 mg/l, which is largely calcium bicarbonate.

Water from streams that derive their base flow from the Tuscaloosa Group and from the McShan and Eutaw Formations generally is the least mineralized of all low flow water in the basin. No individual chemical constituent attains a concentration of more than a few milligrams per liter, and the dissolved-solids content is generally less than 30 mg/l.

Ground Water Quantity and Quality - The major aquifers in the basin are the Lower Wilcox aquifer, Meridian-upper Wilcox aquifer, Sparta Sand, Cockfield Formation, and Mississippi River Valley alluvium aquifer. Minor aquifers (or major aquifers classified as minor aquifers because of their limited areal extent in the Yazoo-Mississippi River Basin) are the Gordo, Eutaw, and Ripley Formations and the Coffee Sand in the northeast part of the basin; the middle part of the Wilcox Group, the Tallahatta Formation, and the Winona Sand in the northwest, central, and western parts; and the Forest Hill sand, Mint Spring Marl Member of the Marianna Limestone, Vicksburg Group, and Catahoula Sandstone in the extreme south.

Cretaceous aquifers yield fresh water in Benton, Calhoun, Lafayette, Marshall, Pontotoc, and Union Counties. Water from the Gordo is commonly suitable for municipal use without treatment; however, the dissolved-solids content exceeds 500 mg/l in much of the area where it is used.

The Eutaw Formation is available in approximately the same areas as the Gordo, but due to low yields to wells and to the high mineral content of the water, it is not generally used for municipal or industrial supplies. The largest withdrawals from the Eutaw, about 0.8 mgd, are made at New Albany, Union County, Mississippi, where the water is of good quality.

The Coffee Sand, a source of water in Benton, Lafayette, Marshall, Pontotoc, and Union Counties, is a low-yielding aquifer but the quality of the water is generally good. The Ripley Formation is a source of water for small to moderate capacity wells as far west as northeastern Calhoun, eastern Lafayette, and Marshall Counties and probably contains fresh water in eastern DeSoto County.

Water use from the cretaceous aquifers in the basin was about 4 mgd in 1970. These aquifers are estimated to be capable of yielding about 20 mgd.

1/ Outside the hydrologic boundary.

The Tertiary aquifers include the lower Wilcox, the middle Wilcox, the Meridian-Upper Wilcox, the Tallahatta Formation and Winona Sand, Sparta Sand, the Cockfield Formation and Forest Hill Sand, Vicksburg Group, and Catahoula Sandstone.

The lower Wilcox is a major source of ground water in DeSoto, Panola, Quitman, Tate, and Lafayette Counties. It is of less importance in other counties because the sand beds are commonly thin and irregular. Water in the lower Wilcox becomes saline in Coahoma, Tallahatchie, Leflore, and Holmes Counties.

Water from the lower Wilcox aquifer is commonly suitable for most uses without treatment and it is the most desirable source of water for municipal and community water systems in the northwestern part of the basin. The water is soft, a sodium bicarbonate type, and generally is free of objectionable quantities of iron and other constituents.

Water used from the Wilcox aquifer in 1970 totaled about 4 mgd. It is estimated to be capable of yielding about 60 mgd in the basin without an excessive decline in water levels.

The middle Wilcox aquifer is characterized by irregular sand beds in the middle part of the Wilcox Group. These beds are thick enough in some places to be ground water sources for public and industrial water supplies. Several moderate-capacity wells now tap middle Wilcox sands in Panola and adjoining counties. At some sites the middle Wilcox sands are not utilized because the water is corrosive or contains excessive iron in solution.

It is estimated that the middle Wilcox aquifers are capable of yielding about 8 mgd. Further study may show the aquifer to be more extensive than is now indicated.

The Meridian-upper Wilcox aquifer is a widely used source of ground water in the basin -- a result of areal extent, high water levels, good quality water, and favorable hydraulic characteristics. High water levels prevail, although declines have been large in many areas and significant elsewhere. Initial water level declines were the result of the large number of uncontrolled flowing wells made in the aquifer in the Mississippi Alluvial Plain. Later declines were the result of the general development of the aquifer for municipal and industrial supplies. Declines are especially large in DeSoto County as a result of pumping at Memphis from the Memphis Sand, the lower part of which is equivalent to the Meridian-upper Wilcox aquifer. Water levels in some parts of the basin are still high; for example, in part of Yazoo County, the potentiometric surface is more than 100 feet above land surface.

Where the Meridian-upper Wilcox aquifer occurs at shallow to moderate depths (200 to 1,000 feet) the water is low in dissolved solids but generally requires treatment for pH adjustment or iron removal. In areas further down the dip, the water is a soft sodium bicarbonate type that is suitable for general use without treatment. In the southwestern part of the basin, the water is a sodium chloride type.

Withdrawals from the Meridian-upper Wilcox aquifers in 1970 amounted to about 30 mgd. The aquifer is capable of yielding over 70 mgd without serious consequences if a reasonable distribution of withdrawals is made.

The Tallahatta Formation is composed of thin-bedded sand and clay and includes irregular thick beds of sand. The Winona Sand is a marly or silty sand overlying the Tallahatta Formation. Both formations are water bearing and are primarily used as sources of ground water for domestic and other small wells. A few public water supply wells in the northern part of the basin obtain water from the Tallahatta Formation.

Water from the Tallahatta Formation and Winona Sand is low to moderate in dissolved solids. The water is generally suitable for most uses without treatment. Water use is estimated to be about 0.3 mgd.

The Sparta Sand crops out in the uplands in the northeastern part of the basin. The regional dip in the basin is westward towards the axis of the Mississippi Embayment. The formation thickens to the west and south, attaining a maximum thickness of about 800 feet in the extreme southern part of the basin. The Sparta is composed of irregularly bedded sand and clay.

The quality of water in the Sparta Sand is generally good although in the northern part of the basin treatment for iron removal is needed in some places. In other areas, where the aquifer occurs at shallow to moderate depths, the water is corrosive due to high carbon dioxide content. In the southern part of the area, the dissolved-solids content ranges from 500 to 1,000 mg/l.

The Sparta is the principal source of ground water for municipal and industrial supplies at Cleveland, Clarksdale, Yazoo City, and numerous smaller municipalities in these areas. The largest withdrawals from the Sparta are in the Yazoo City area, where about 7 mgd is pumped. The present total pumpage from the Sparta is about 30 mgd. Although water levels have declined throughout the basin, the Sparta is capable of yielding about 140 mgd.

The Cockfield Formation crops out in the uplands of Carroll, Holmes, and Yazoo Counties. The formation underlies and is

hydraulically connected to the Mississippi River Valley alluvial aquifer in the central part of the Yazoo subbasin. In the southern part of the Yazoo subbasin, the Yazoo clay of the Jackson Group forms a confining layer above the Cockfield. The formation attains a maximum thickness of about 600 feet in Washington County.

Water from the Cockfield is generally a soft sodium bicarbonate type. Color is a troublesome characteristic in some localities, and the dissolved-solids content is high in the southwestern part of the area.

The largest withdrawals of water from the Cockfield are at Greenville where about 14 mgd is produced. About 2 mgd is pumped at Leland. The total withdrawal from the Cockfield Formation is about 17 mgd, and the estimated potential yield of the aquifer is about 25 mgd.

The Forest Hill Sand and Vicksburg Group crop out in Warren County and extreme southwestern Yazoo County. The Catahoula Sandstone is restricted to central and southern Warren County. All are water bearing to varying degrees but none is capable of yielding large quantities of water to wells. The Forest Hill and Catahoula are capable in some localities of yielding a maximum of 200 to 300 gpm to individual wells, but average yields are much lower. The Mint Spring Marl Member (of the Marianna Limestone) and the marls and limestones of the overlying Vicksburg Group in places yield up to about 10 gpm to domestic and other small wells.

Water quality is quite variable in the Forrest Hill Sand and Catahoula Sandstone. At places, the water requires treatment for hardness, excessive iron, or corrosiveness. Water from the Mint Spring Marl Member is generally suitable for domestic use without treatment.

The Mississippi River Valley alluvial aquifer is the only significant Quarternary aquifer in the basin. The alluvium averages about 140 feet in thickness, and the lower sand and gravel part forms an aquifer averaging about 80 feet in thickness. The aquifer is replenished principally by infiltration of precipitation where the upper part of the deposits is permeable. Lateral movement of ground water recharges areas overlain by impermeable clay and silt.

Water from the Mississippi River Valley alluvial aquifer is moderately mineralized and hard, and generally contains several milligrams per liter of iron in solution. It is suitable for irrigation and cooling. With treatment, the water in many places is suitable for municipal and other uses.

Most of the total of 267 mgd now withdrawn from the alluvial aquifer is for irrigation, principally of rice. About 50 mgd is used for cooling and about 7 mgd is produced for the municipal water supply at Vicksburg. The estimated potential yield from the aquifer in the basin is slightly more than 1,700 mgd; however, this potential yield would be much larger if well fields were located along the Mississippi River or near major streams where hydraulic conditions favor infiltration.

Vegetation

The 1970 cropland base in the basin is estimated at 3.6 million acres. The major crops produced in terms of acreage were soybeans, cotton, hay, corn, and rice.

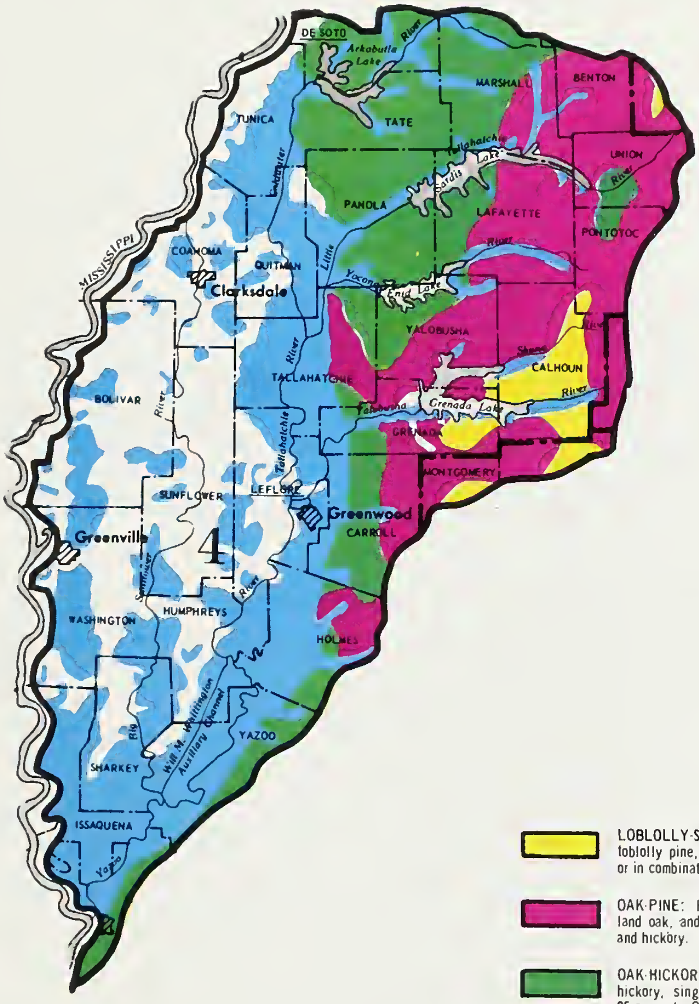
Since 1954 soybean acreage has tripled, with new plantings averaging around 70 thousand acres a year. Corn has been practically eliminated as a viable crop and cotton acreage is about one-half the size of 20 years ago. Pastured cropland has declined by about 250 thousand acres, and hay crops have declined 100 thousand acres since 1949.

There were approximately 1.9 million acres of land utilized for the grazing of livestock within the basin. Of this 943 thousand acres are permanent pasture. The remaining acreage is made up of 326 thousand acres of pastured cropland and 587 thousand acres of pastured forest land.

Primarily, there are two types of land used for pasture. These are summer and winter pastures. Summer pastures generally utilize grasses such as bermuda and bahia while winter pastures utilize improved grasses such as oats, winter wheat, ryegrass, and fescue.

Forest land occupies 3.2 million acres, or 35 percent of the total land area. Major forest timber types by subareas are shown in table 2.7. Also, map 2.3 shows the general location of these forest types.

The majority of the oak-gum-cypress and elm-ash-cottonwood forests which makeup the bottomland hardwoods, are found in the Mississippi Delta Alluvium. These types also occur along the flood plains of upland streams. Oak-hickory forests occur in the north central portion of the area and extend as a narrow band down the loessal bluffs, bordering the "delta" to the southern tip of the area (LRA 134, Southern Mississippi Valley Silty Uplands). Oak-pine and loblolly-shortleaf pine types occur in the eastern portion of the area (LRA 133, Southern Coastal Plains).



SCALE IN MILES

10 0 10 20 30

LEGEND

LOBLOLLY-SHORTLEAF PINE: Forests in which 50 percent or more of the stand is loblolly pine, shortleaf pine, and other southern pines, except longleaf or slash, singly or in combination. Common associates include oak, hickory, and gum.

OAK-PINE: Forests in which 50 percent or more of the stand is hardwood, usually upland oak, and southern pines make up 25-49 percent. Common associates include gum and hickory.

OAK-HICKORY. Forests in which 50 percent or more of the stand is upland oak and hickory, singly or in combination, and southern pines or redcedar make up less than 25 percent. Common associates include gum, yellow poplar, elm, and maple.

OAK-GUM-CYPRESS: Bottom-land forests in which 50 percent or more of the stand is tupelo, blackgum, sweetgum, oak, and southern cypress, singly or in combination, and southern pines make up less than 25 percent. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

NONTYPED: Land less than 10 percent forested.

MAP 2.3

FOREST TYPES MAP

YAZOO–MISSISSIPPI RIVER BASIN

Material prepared by Field Personnel – Reproduction only by SCS Cartographic Unit, Fort Worth, Texas.

JUNE 1975 4–R–35016

USDA-SCS-FORT WORTH, TEX. 1975

Table 2.7. Forest types, Yazoo-Mississippi River Basin, 1970

Subarea	Loblolly Shortleaf	Oak Pine	Oak Hickory	Bottomland Hardwoods	Total
	Acres				
Uplands	695,100	198,700	1,180,700	201,000	2,275,500
Delta	0	0	0	946,500	946,500
Total	695,100	198,700	1,180,700	1,147,500	3,222,000

Source: U. S. Forest Service.

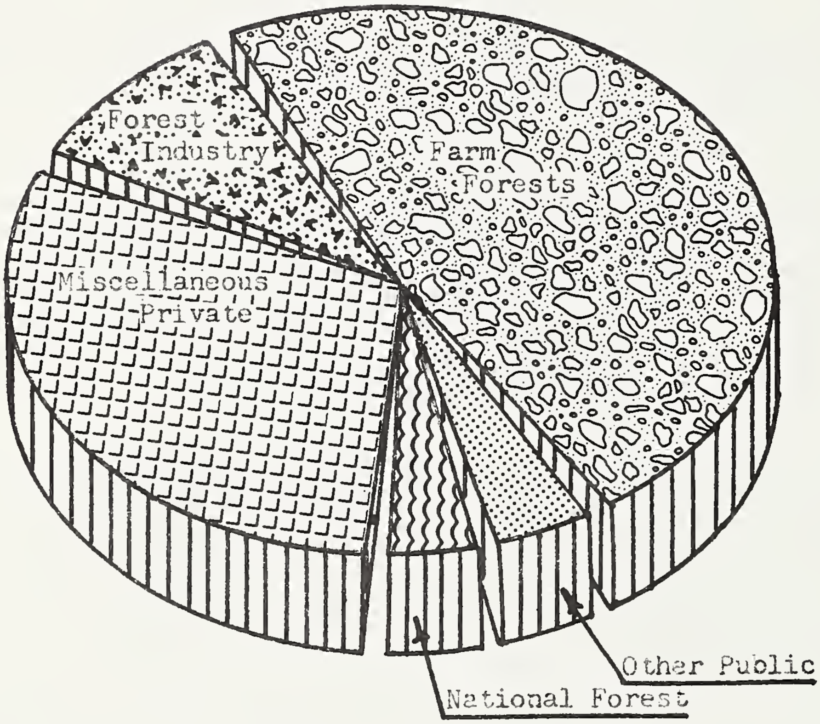
Ownership of the 3.2 million acres of forest land is comprised of 2.9 million acres of privately-owned and 361 thousand acres of publicly-owned forests. Almost nine of every ten acres of commercial forest land in the basin is in private ownership. Out of this total private ownership 322 thousand acres are owned by forest industry, 1.6 million acres are in farmer ownerships, and 967 thousand acres are in the miscellaneous category (figure 2.1).

Forest industry and public forest lands contain a higher percentage of growing stock volumes than farmer and miscellaneous private forest lands. The longer rotations and larger build-up of growing stock on public lands, especially the National Forest, is necessary because management objectives are to produce a broad choice of forest products and produce a wider range of services to the public. Forest conditions indicate of the total 3.2 million acres of forest land within the basin, 1.0 million acres is 70 percent or more stocked with desirable trees. The major portion of the forest land falls in the 40 to 70 percent stocking with 1.4 million acres in this class. The remaining 807 thousand acres are less than 40 percent stocked with desirable trees (figure 2.2).

Fish and Wildlife

Basin fish and wildlife include small game animals, big game, fur-bearing animals, waterfowl, game fish species, and non-consumptive wildlife resources. Commonly-hunted small game animals are mourning dove, gray and fox squirrel, bobwhite quail, and cottontail and swamp rabbits. Big game animals in this area are the white-tailed deer and the eastern wild turkey. Wood ducks are native to the basin, producing about 25 percent of the annual waterfowl harvest, and are joined by their migrant cousins, the mallard, blue-winged teal, green-winged teal, pintail, black duck, widgeon, gadwall, shoveller, scaup, ring-necked, bufflehead, red-head, canvasback, and ruddy duck.

Figure 2.1: Forest land ownership, Yazoo-Mississippi River Basin, 1970



LEGEND

Forest Industry 322,000 acres

Farm Forests 1,572,100 acres 1/

Miscellaneous Private 966,600 acres 2/

National Forest 200,000 acres

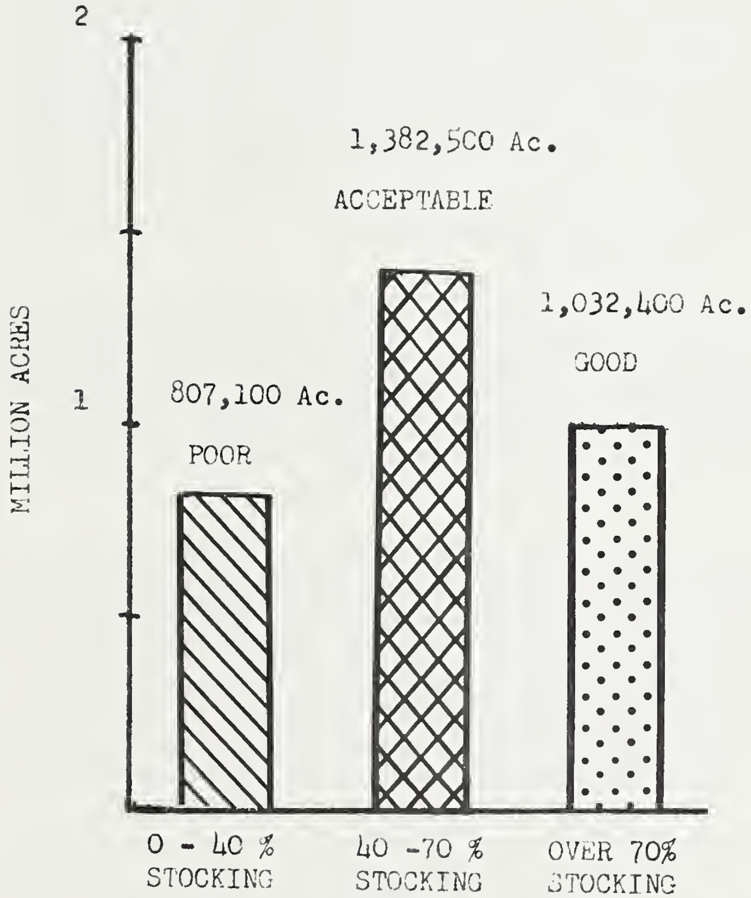
Other Public 161,100 acres

Source: USDA, Forest Service

1/ Includes farmer and farmer leased to forest industry.

2/ Includes individual and corporate with both leased to forest industry.

Figure 2.2: Condition of the forest resource by acres and stocking class, Yazoo-Mississippi River Basin 1970



Source: Based on U. S. Forest Service Forest Survey

Fur-bearing animals most commonly harvested are muskrat, mink, raccoon, fox beaver, skunk, and opossum. Major game fish species are the largemouth bass, bluegill sunfish, red-eared sunfish, black crappie, white crappie, channel catfish, blue catfish, flathead catfish, and bullhead catfish.

Non-consumptive wildlife resources are those animals, plants, or natural systems which attract people who observe the natural phenomena without otherwise using the resource. Bird watching, nature study, and wildlife photography are the major non-consumptive wildlife pursuits.

All wildlife resources are limited by the amounts, quality, and juxtaposition of adequate habitat. Wildlife habitat within the basin varies in all three criteria. There are 1,148 thousand acres of bottomland forest. About 80 percent is located in the delta. This forest type is the most productive for forest game species (deer, squirrel, turkey). This is because the soils are the most fertile, plant food species are abundant, water is abundant, and interspersed bottomland crops (soybeans, corn, sorghum, cotton) provide additional food and cover.

There are 1,382 thousand acres of upland hardwood forest which are productive for forest game, second only to the bottomland forest. There are 199 thousand acres of pine hardwood habitat and 695 thousand acres of pine habitat in the basin. These latter two types are the least productive forest game habitat with pine being the lesser of the two.

Waterfowl resources are excellent in the delta and fair in some areas of the uplands. Frequent winter time flooding of low-lying bottomland hardwood forest and soybean fields produce thousands of acres of prime feeding and resting habitat. In the 1972-73 season, mallards comprised approximately 64 percent of the total harvest and wood ducks about 25 percent. The basin harvest of waterfowl was 58 percent of the total state harvest, an indication of the abundant waterfowl resource found within the basin. The delta harvest of waterfowl was 83 percent of the basin total and approximately 48 percent of the state harvest.

Fishery resources are adequate in number, size, distribution, and quality. Large water areas provide 90 thousand acres of fishery habitat.1/ In addition, there are 103 thousand acres of smaller lakes scattered throughout the basin. Although used much less than the lakes, there are 1,100 miles of streams which are capable of supporting a fishery resource. Approximately 11 percent of the basin residents buy fishing license. Total fishing pressure is much greater due to the influx of non-resident fishing pressure and pressure from residents not requiring a license.

1/ Over 40 acres in size.

Hunting resources are spread throughout the basin and utilized to some degree by 21 percent of the residents. Squirrel, dove, rabbit, deer, quail, and duck are eagerly sought by hunters. Non-resident participation on hunting resources is not as high as such pressure on fishery resources.

There are some rare and endangered wildlife species which exist in the basin. The American alligator is found in certain wetland areas in the delta. Red-cockaded woodpeckers may inhabit isolated over-mature pine stands in the uplands. Rarely seen and precariously existing in the basin, are the coyote, red wolf, and black bear. There are several rare and endangered birds which migrate through the basin, including the bald eagle, peregrine, falcon, and others. The southern bald eagle, once a common resident, may have vanished completely from the basin although there were reports of one or two birds from the lower end of the basin within the past two years.

Minerals

Oil and gas are produced in the southern part of the basin. Geological conditions are favorable for oil and gas northward into the central portion of the basin. Lignite deposits exist in the southern and eastern areas. Some of the lignite deposits may be developed in future years. Lignite is significant in its use as a fuel in electric power generation and as a feedstock for the production of activated carbon.

Currently, oil and gas output in the southern part and widespread production of construction minerals define the mineral industry activity in the basin. Sand and gravel is produced in more than half the counties in any given year to meet local needs. Clay is produced in several counties, mostly for local consumption, and stone is produced in Warren County. Cement is manufactured in Warren County from locally produced minerals for regionwide markets.

In 1969, the total value of mineral output in the basin was approximately $14.7 million (table 2.8). The value was about equally divided between fuels and nonmetallic minerals.

Land use by the mineral industry is a small fraction of total acreage in the basin. Mineral industry land use amounted to an estimated 3.3 thousand acres in 1969. Also in 1969, mineral industry water needs were an estimated 1,205 acre-feet of diversions and 598 acre-feet of depletions. Water and land needs to support projected mineral output through the year 2020 are presented in Chapter IV.

Table 2.8. Mineral production and value, Yazoo-Mississippi River Basin, 1969

Commodity	Unit	1969 Quantity	1969 Value
			$1,000
Cement:			
Masonry	280 pound barrels	1/	1/
Portland	Thousand 376 pound barrels	1/	1/
Clays	Short tons	303,904	1,643
Natural gas	Million cubic feet	112	20
Petroleum	Thousand barrels	2,627	7,663
Sand and gravel	Thousand short tons	3,451	3,900
Stone	Thousand short tons	1/	1/
Basin	XXX	XXX	14,718

Source: Related Mineral Resources, Appendix G, Lower Mississippi Region Comprehensive Study.

1/ Withheld to avoid disclosing company confidential information.

Stream Characteristics

The stream systems in the basin are an integral part of the present environment. To better characterize and inventory their qualities a study of 61 selected streams was conducted. Each stream was inventoried at point locations, selected as representing the stream, and the data recorded (see table 2.9).

For the purpose of this study the streams were grouped into three categories. Delta streams are those located in areas 1-8. Upland streams are those in areas 9-13 and because of their significance, the major rivers below the Corps of Engineers Reservoirs were grouped together into a separate category.

Delta - The delta streams are typical of slow, meandering, tree-lined streams. Seven of the twelve inventoried streams contained portions where the streams were in a natural condition. Of the forty-five inventory points, twenty-five were on streams in a natural condition and twenty were in an altered condition. It is significant that 25 of the 45 inventoried points on the smaller, perennial delta streams are natural in appearance. This points out that there are many attractive delta streams left in this intensively agriculturized region.

Most delta streams have silt bottoms and are stable insofar as bank erosion and bed-load movement is concerned. These streams are typically sluggish, often containing small lakes or wooded brakes within the stream. This is reflected in the average width of the streams being 190 feet wide.

Table 2.9. Summary of selected physical stream characteristics and ratings for specified uses, Yazoo-Mississippi River Basin, 1974

Item	Delta	Uplands	Large rivers	Basin total
Total number of inventory points	45	108	24	177
Stream overall condition				
Natural	25	48	15	88
Altered	20	60	9	89
Stream bed				
Sand	4	67	1	72
Gravel	-	6	-	6
Silt	41	24	21	86
Clay	-	11	2	13
Streambanks and beds				
Stable	39	60	22	121
Unstable	6	48	2	56
Average width of water	190'	20'	206'	N/A
Streams rated for:				
Recreation				
High	4	12	1	17
Medium	19	30	18	67
Low	22	66	5	93
Fish and wildlife				
High	23	28	14	65
Medium	20	37	9	66
Low	2	43	1	46
Scenic				
High	13	10	3	26
Medium	18	30	16	64
Low	14	68	5	87
Need for stream preservation				
High	6	21	2	29
Medium	5	29	9	43
Low	34	58	13	105

Source: Soil Conservation Service, United States Department of Agriculture.

From a wildlife-fisheries resource standpoint the delta streams containing widened, wetland areas are extremely valuable. These areas are generally wooded, containing tupelo gum and bald cypress in the overstory and swamp privet, water elm, button willow, and black willow in the understory. Many species of animals, birds, reptiles, amphibians, and fish live in and around these wooded areas.

Delta streams are generally surrounded by open expanses of soybeans and cotton. Very few streams transect large wooded areas, but most are bordered with bottomland hardwood species such as pecan, sycamore, cottonwood, black willow, hackberry, oaks, button willow, swamp privet, and cypress. These meandering streams with their timbered borders provide excellent wildlife habitat and travel corridors for terrestrial wildlife and provide a pleasing tree line to an open landscape. A considerable amount of the timber left in the delta is along streams and lakes.

Delta streams are rated medium-low in recreation use, medium-high as fish and wildlife habitat, fairly equally distributed between high, medium, and low when rated for scenic attraction, and generally low when considered for stream preservation qualities.

Most delta streams have a high turbidity problem caused by suspension of silt particles in the water. Some streams never clear up and others do only for short periods during drought condition. Fish populations are generally poor. Bass are almost totally absent from these streams and bream make up a small total of the standing crop. Channel catfish do well and are the species most sought after. Considerable use is made of these streams to catch or gig bull frogs during the summer months because of high frog populations.

Upland - Upland streams are generally narrow, fast flowing, fairly shallow, and sandy bottomed. There were 108 inventory points on 42 streams in the uplands. Forty-eight of these points were on streams in a natural condition and 60 inventory points were taken where the stream was in an altered condition. The greater preponderance of altered conditions in upland streams over delta streams is possibly due to the upland areas being in the Yazoo-Little Tallahatchie Flood Prevention Area where many flood prevention projects have been installed which included stream alterations.

Streambeds in the uplands show much more diversity than delta stream bottoms. Sand, silt, and clay are the predominant bottom stratas with sand being the most common. Many of the upland streams, both altered and non-altered, carry heavy bed loads of sand. This creates a flow that shifts about and is unstable, as is borne out by 48 of the inventory points having unstable banks and beds.

The average width of the water of upland streams was 20 feet. In many cases the narrow water area is located in a broad sandy

bottom and is shallow and without vegetative cover. Because of the sand bed load in many upland streams, the original bottom configuration has been covered by sand and the stream is fairly uniform in depth, usually shallow, and without holes or other cover areas for fish.

Upland streams generally ranked lower for recreation use than delta streams. The rating for fish and wildlife use and potential was also much lower than delta streams. The proximity of other better fishing waters and abundance of wildlife habitat in the uplands could explain these lower ratings for recreation and fish and wildlife use. Streams and their associated values are more important as recreation and fish and wildlife resources in the delta setting than are upland streams in their setting.

Only ten of the 108 inventory points were rated high for scenic attraction and 68 were rated low, while twenty-one streams rated high for stream preservation and fifty-eight rated low.

Generally, game fish populations in the upland streams are poor. Some streams that are influenced by the reservoirs do support a good fishery near the lower ends where the reservoir influence is present.

Upland streams tend to pass through a more diverse landscape than do those in the delta. Pasture and large woodland areas are more common in the uplands. Even so, most upland streams are in bottoms which support a high degree of agricultural use.

The woodlands along upland streams are bottomland hardwood species with oaks, sycamore, cottonwood, black willow, tag alder, birch, beech, and cypress the most common species found.

Large Rivers - The larger rivers were placed in a separate category. All of the other streams eventually drain into one of these rivers.

These rivers average 206 feet wide and generally have deep channels. The Yazoo River is navigable to Belzoni and sometimes to Greenwood.

There were twenty-four inventory points on these rivers. Fifteen of these points were at natural condition reaches and nine were at places that were altered in appearance.

All of these rivers have received some alteration in past years. Cutoffs, dredging, stabilization, or other modifications have been completed as part of Corps of Engineers projects.

Silt is the predominant stream bed strata. Turbidity is generally a problem except during long periods of low flows. The Big Sunflower River tends to clear faster than the other rivers.

Of 24 inventory points, 22 had stable streambanks and beds. Large trees are usually present along these rivers. This band of timber extends up the slope and along the top bank, and this vegetation has a stabilizing effect on caving and erosion. Pecan, cottonwood, sycamore, oaks, black willow, cypress, and various understory plants are commonly found along these rivers.

Recreation received a medium rating. Boating, fishing, skiing, and sightseeing occur on most of these rivers. Fish and wildlife resources ranked medium to high. As previously discussed, these timbered corridors in the delta are very important to wildlife values. Fish populations vary from river to river. Catfish are abundant and are the most eagerly sought after game fish. Bream, crappie, and bass occur in some reaches of these rivers, especially near the confluence with smaller streams harboring good game fish populations and near the outlet of the major reservoirs.

The scenic value placed on larger rivers in the basin was medium. Even though these rivers have been altered at different times and to different degrees, their size and tree-lined banks create a scenic setting. The Yazoo, Yalobusha, and the Tallahatchie Rivers are generally the most scenic. The potential for stream preservation was low.

Environmental Features

Significant environmental features in the basin include essentially undeveloped landforms, water bodies, and forests. One of the most outstanding landforms is that portion of the Delta Hills Bluffs in Carroll and Holmes Counties. Significant water bodies include numerous aesthetically pleasing lakes, most of which are in the delta. Significant bottomland hardwood forests are scattered throughout the basin. Scattered tracts of wetlands are associated with the stands of bottomland hardwoods and there are several unique ecological systems, such as McIntyre Scatters and Matthews Brake, associated with the lake areas. There are, however, no significant beaches and shores in the basin other than those associated with natural inland lakes and man-made impoundments, and there is a general lack of open and green space in urban areas.

Open and Green Space - Out of a total of 258 thousand acres of urban and built-up land in the basin, there are less than three thousand acres of undeveloped, attractive natural areas needed to modify intensifying urban patterns.

Scenic Rivers and Streams - Few of the rivers and streams possess outstanding scenic qualities, although they do have characteristics that contribute to the environmental quality. The winding, forested river banks add a pleasant tree line to the flat delta landscape. Much of the scenic beauty the waterways had in the past has deteriorated due to heavy siltation and extensive channel modification.

Lakes - There are virtually no natural lakes in the upland area of the basin. The delta, however, has innumerable natural lakes, most of them oxbow cutoffs created by sluggish, meandering alluvial streams. Many of these lakes and their associated wooded brakes or backwater areas have long, enviable histories of fishing and hunting excellence. McIntyre Scatters, Matthews Brake, Sharkey Bayou, Mossy Lake, Eagle Lake, Wolf Lake, and numerous other similar water bodies are vital components of the delta oxbow system.

Wilderness Areas - The only area closely resembling a wilderness is McIntyre Scatters, an extensive backwater area adjoining McIntyre Lake, north of Greenwood. Areas having truly extraordinary wildlife populations are Eagles Nest Brake, McIntyre Scatters, Sharkey Bayou, Delta Wildlife Refuge, and Matthews Brake. These areas abound with deer, turkey, squirrel, waterfowl, and other game species.

Wetlands - Closely associated with, and critically important to, the delta resource base are the tracts of wetlands such as undisturbed marshes, swamps, and overflow bottomland hardwood forests. These areas provide nursery and breeding grounds for the fishery and wildlife that depend upon the swampy ecosystem for food and shelter. Squirrel, white-tail deer, wild turkey, rabbit, and many game species of waterfowl and fish reside in these delta lowlands.

Bottomland Hardwoods - The 1.1 million acres of bottomland hardwoods and associated wetlands in the basin are scattered throughout the area. Most stands are in small privately-owned blocks and strips of bottomland hardwood timber along lakes and streams. The present status is such that many acres will be cleared within the next 50 years if measures are not taken to modify present trends.

Unique Geological Systems - The only recognized unique geological system in the basin is a 1,055-acre portion of the Delta Hills Bluff. This escarpment in Carroll and Holmes County is relatively undeveloped and is largely an upland hardwoods-pine forest.

Unique Ecological Systems - The Sharkey Bayou Area, Beckam Swamp, Ashland and Gayden Brakes, and several additional areas represent valuable ecological systems in the basin. The interdependent physical and biotic environments of these and other similar systems possess aesthetic values and contribute to the diversity of the basin.

Historical Aspects

The history of agricultural development in the uplands is generally one of land misuse, abuse, and decay, stemming primarily from poor conservation practices in the production of two "clean-tilled" row crops, cotton and corn. In the last 25 years, however, there has been some restoration and improvement in this condition.

The first white settlers came to the hills from Virginia and the Carolinas around 1800. They established an agricultural economy centered around corn and cotton production, and by the late 1930's more than 60 percent of the total farm population of the hills was dependent primarily upon cultivated land for cash earnings. As the flatter upland areas became overcrowded, farming was begun on the hillsides, exposing the loosely compacted sandy loam to the erosive forces of wind and water. Uncontrollable erosion followed and farmers, in final desperation, deserted their farmsteads because they could not eke out a living on land unsuited for cotton or corn.

By the 1930's a yearly average of 100 million tons of sand and sediment poured into the hill streams from land eroding at rates as high as 300 tons per acre. Sixty-five percent of the bottomland suffered from annual flood and sediment damage. Drainageways were so stifled that rains of less than one inch caused widespread inundation. Poor management practices and ravaging fires caused a dramatic reduction in both quality and productivity of the forest resources. The hills were a virtual wasteland.

Beginning in 1944, Congress provided for Federal participation in planting trees, grasses, and legumes on the unprotected hillsides to retain the soil and reduce the magnitude and intensity of storm runoff. Between 1948 and 1970, 547 thousand acres have been planted to loblolly pine trees. Approximately 312 thousand acres of grasses and legumes were planted in the same time period and thousands of brush dams were built to stop erosion, helping return extensive land acreage to beneficial agricultural production.

Erosion has been greatly checked by intensive land management practices but the economic benefits of timber and desire for pasture conversion is creating cause for concern. About 12 percent or 3.5 thousand acres of the acreage planted 15 years ago have been cleared for pulpwood production or for pasture.

Today, due to the Yazoo-Little Tallahatchie Flood Prevention Project (Y-LT), much stability has been restored to the overall natural environment of the hills. The forestry base is still quite diversified, although extensive pine plantations have replaced the mixed pine-upland hardwood timber that was cleared by early agriculturists. The upland environment is internally independent;

therefore, pressure induced in one area from endeavors such as land clearing do not affect surrounding areas as severely as such practices do in the delta.

In the delta, historical development has largely centered around the countless, intermingled complexities of a single, continuing endeavor--land reclamation. Land reclamation has significantly altered the natural hydraulic, terrestrial, and topographic aspects of the delta, causing a change in the natural environment. Even so, an intricate system of oxbow lakes and associated "brakes" or "scatters", created by meander patterns of the Yazoo, Sunflower, Coldwater, Yalobusha, and Tallahatchie Rivers, provides aesthetic diversity to the appearance of the delta, and serves as an outstanding environmental support system for a wide variety of fish and wildlife.

In order to grow crops in the delta, the early settlers had to clear their farmland and construct earthen revetments to provide protection against fierce, damaging floods. In 1819, and again in 1846 and 1848, the State of Mississippi enacted legislation concerning levee building in the delta, which until 1848, was an almost impassable swamp, with little habitation and virtually no farming, save for that on a few scattered patches of high ground that did not flood annually. As the Mexican War drew to a close in 1847, immigration to the delta increased sharply, primarily due to the promotional efforts of land companies.

In 1849 and 1850, the Federal Swamp Lands Acts were passed, thus bringing the United States Government into flood control and other aspects of land reclamation. Over three million acres of overflow swamp land were given to the State of Mississippi, on condition that revenues from the sale of the land would be applied to flood control, land drainage, and related endeavors. Significant progress in flood control work was made in the late 1800's but the 1927 deluge dispelled all feelings of false security in the basin. As a result of devastation in 1927 and again in 1928, Congress passed new legislation in 1928 providing for extensive levee building in the area. The "levees only" concept, the only flood control technique employed to that time, was displaced by newer concepts involving reservoirs, floodways, bendway cutoffs, bank stabilization, and other structural measures.

Land drainage progressed simultaneously with flood control efforts. Drainage laws were passed by the Mississippi Legislature in 1886, 1900, and 1906, relating to swamp land districts established under the Federal legislation of 1850. Languishing drainage programs were spurred in 1944, when flood control was re-defined by Congress to include major drainage projects and improvements. With the new legislation, the federal government became more actively engaged in

projects not directly involving levee construction. Several major drainage works were subsequently included in the federal projects in the delta.

Land clearing, which usually succeeds and is often induced by flood control and drainage improvements, was rapid from 1900 to the beginning of the first World War, but then tapered off sharply until the end of World War II. From 1935 to 1950, forest land in the delta decreased by 9 percent, leaving almost 37 percent forested acreage in 1950. There was a slight increase in total forest acres in the basin for the period 1945-1959 due to the reforestation efforts of the Yazoo-Little Tallahatchie Flood Prevention Project. Within this same period, (1945-1959) 148 thousand acres of forests were cleared in the delta and flood plains. In total clearing operations from 1945 to 1959, over 310 thousand acres of delta land were denuded. Since 1959, there has been a steady decline in forest acres mostly due to clearing for row crops and pasture.

CHAPTER III

THE BASIN ECONOMY

General

The need for conservation, development, utilization, and management of water and land resources is related to the present and expected economic activity in the basin. Past, present, and expected future indications of economic activity were developed to establish an economic setting and general framework for planning.

Approach and Methodology

The general approach used to establish the economic setting of the basin - past, present, and future - consisted of several steps: (1) inventory of historical data pertaining to the basin; (2) the delimitation of subareas in the basin that are relevant to problems and needs; (3) analysis of past growth and the present economy, including a determination of dominant trends and a review of the principal factors and conditions that induced changes; (4) analysis of the nation and Lower Mississippi Region economies to determine dominant trends affecting the basin and to establish relationships of growth in the nation and Lower Mississippi Region to growth of the basin; (5) identification and analysis of employment in and income from major water-using industries and other industries in the basin; (6) development of statistical and other projection methods to be used in estimating the future demographic and economic change in the basin; (7) an appraisal of the principal factors and conditions likely to affect economic change in the basin during the projection period; and (8) development of the final projection of each economic indicator.

Data for the 30 counties comprising the basin were adjusted to the share applicable to the hydrologic boundary. Methods of analysis and projections include linear regression, step-down correlation, comparison to larger areas, historical rates of change, changes as related to other variables, and professional judgement. To facilitate the determination of trends and prospective changes in the nation which would influence the economic future of the basin, Water Resources Council projections were used to establish a frame of reference for the projected basin parameters.

The General Framework of Assumptions

The projections presented in this report are geared to the OBERS[1] projections that are shaped by long-run or secular trends in the economy rather than by the cyclical fluctuations which characterize the short-run path of development. Assumptions, either explicit or implicit, that reflect this general principle are as follows:

(1) Growth in population will be conditioned by a substantial decline from the fertility rates of the 1962-1965 period;

(2) Reasonably full employment will prevail at each of the projection points;

(3) At projected dates, the economy is considered free of the destructive effects of foreign conflicts;

(4) Stability will be maintained in the conduct of international trade;

(5) Continued technological progress and capital accumulation will support a growth in output per man hour of 3 percent annually;

(6) Development of new products will be accommodated within the existing industrial classification system;

(7) Growth in output within the context of the existing industrial structure can be achieved with environmental balance although this may require control of energy resources, restriction of the use of pesticides and other chemical products, and encouragement of population dispersion; and,

(8) The historical trends in import/export activity are extended into the future except for agricultural exports which, though continuing to increase, will constitute a smaller percentage of U. S. production.

Basin projections are based on the assumption that factors influencing historical trends will continue into the future. Basin trends were modified where limitations in the resource base were known or anticipated or where other critical developments appeared highly probable.

1/ Economic projections prepared by the Bureau of Economic Analysis, U. S. Department of Commerce, and the Economic Research Service, U. S. Department of Agriculture--popularly termed OBERS.

Limitations

To predict what will happen in the next half century is a feat beyond the power of social science. The projections should not be interpreted as being precise, specific figures for future years. Rather, they should be utilized as the relative magnitudes, directions, and patterns that may be expected to prevail. For an area as small as the Yazoo Basin, analyses and projections were complex because in many instances sharp fluctuations in the direction or rate of historical economic change provided no satisfactory statistical long-run trend. It is expected that such fluctuations will continue to occur among the smaller economic parameters, thus emphasizing the necessity of evaluating such projections as general long-range trends past 1970, rather than specific projections for the specific years of 1980, 2000, and 2020.

History

When the first white settlers arrived in the Yazoo-Mississippi River Basin, they found dense, almost impenetrable forests and deep clear streams. Wildlife was abundant and streams contained high fish populations.

In their natural state, oak-hickory forests were located in the north portion of the area and extended as a narrow band down the loessal bluffs, bordering the "delta", to the southern tip of the area. Oak-gum-cypress and elm-ash-cottonwood forests covered the Mississippi delta and flood plains of major streams. Oak-pine and loblolly-shortleaf pine types covered the eastern one-half of the basin.

The younger sons of Virginia and Carolina planters cleared the better drained flood plains and terraces along the major streams and in the delta for crop production. Soon fields of cotton and corn dotted the countryside. At first the settlers cultivated only the fertile bench lands along the streams and better drained alluvial terraces in the delta. This first impact was on the oak-gum-cypress and elm-ash-cottonwood forests. For a few years, the basin was the center of wealth and culture for the State of Mississippi.

As early as 1850 trouble developed in the northern hill portion of the basin. The loessal soils in this area are highly erosive. The agricultural system itself was exploitative and the chosen crops invited land deterioration. As pressure developed for more cropland, the steeper slopes were cleared and cultivated. This clearing took place in the oak-hickory, oak-pine, and pine forests. The clean-tilled crops of cotton and corn left the erodible soils exposed year round. Thousands of acres were abandoned to the ravages of erosion.

The War Between the States marked the end of an era and a way of life. Fortunes were lost and large plantations broken into small ownerships. The increased number of small landowners put even more pressure on the erodible soils. They cleared new hillsides which further depleted the land resource.

Reconstruction days for the hill portion of the basin meant only further deterioration. There was little industry and by 1940 the per capita income for this area was among the lowest in the nation.

As the land resources were depleted in the upland portion of the area, row crop production was directed at the level bottomland soils of the delta. In its natural forested state, the delta portion of the area was covered with over four million acres of elm-ash-cottonwood and oak-gum-cypress forests. At present time, less than one million acres of this valuable resource remains. Early logging practices opened much of this land. As the huge trees were removed, lumber companies sold the cleared land to be developed for crop production.

Population

The population of the basin grew steadily from 1870 to 1940. However, it reached its pinnacle in 1940 and since then has gradually declined. Basin population stood at 561,035 in 1970 as opposed to 723,367 in 1940 (table 3.1). The economy based on agriculture would not support population growth after 1940 as it had in the early 1900's. The mechanization of agriculture released thousands of workers to the labor market. Increased mobility accelerated the outward flow of the population seeking jobs and opportunities. The adoption of new technology began to change the economic structure of the basin. Recognizing the importance of a diversified economy, industrial development efforts were initiated and accentuated.

By 1980, the basin population should total approximately 573 thousand, an upturn from its short-run adjustment in agriculture that started in 1940. Industrial development will have begun to assume a greater portion of the work force, stabilizing the economy. Population should continue to expand to approximately 650 thousand in the year 2000, and to 779 thousand in the year 2020 (table 3.1).

Population changes in the subareas have followed the basin trend with the exception of the Yazoo Hills. Here, the population peaked in 1940, then declined until 1960, and increased slightly by the year 1970. The overflow of the Memphis metropolitan area into the subarea was the basic reason for the upturn in population.

Table 3.1. Total population by subarea, Yazoo-Mississippi River Basin 1940-1970, and projected 1980, 2000, and 2020

Year	Subarea: Yazoo Delta	Yazoo Bluff	Yazoo Hill	Basin
	---	---	Number	---
Historical				
1940	443,238	111,194	168,935	723,367
1950	419,658	98,194	156,298	674,150
1960	377,674	86,806	144,086	608,566
1970	326,907	82,225	151,903	561,035
Projected				
1980	336,666	83,044	153,340	573,050
2000	383,741	94,656	171,161	649,558
2020	460,278	113,535	205,299	779,112

Source: Census of Population, United States Department of Commerce, Washington, D. C. Projections adapted from 1972 OBERS.

There are several characteristics of population other than total size that exert influence upon the shape and movement of the economy. One is the extent of urbanization. Urbanization has become almost synonymous with economic growth, for as an area becomes more urban its rate of economic growth tends to increase.

The Yazoo-Mississippi Basin is becoming more urbanized. Urban population comprised 20 percent of the total population in 1950, 30 percent in 1960, and 37 percent in 1970. The basin trend in urbanization is expected to continue into future years. Projections indicate that 41 percent will be urban in 1980, 49 percent in 2000, and 56 percent in 2020.

The rural population of the basin is divided into farm and nonfarm categories. In 1970 the rural farm population made up 21 percent of total rural population and rural nonfarm 79 percent. The rural population of the Yazoo-Delta subarea in 1970 was 71 percent nonfarm and 29 percent farm. In the Yazoo-Bluff subarea, the nonfarm population was 75 percent and the farm population was 25 percent. In the Yazoo-Hill subarea the nonfarm population was 77 percent and the farm population 23 percent of the rural population.

Employment

Employment data by major industries for the basin and subareas for 1970 and projected years are shown in table 3.2. There were

Table 3.2. Employment by major industries, Yazoo-Mississippi River Basin and its subarea, 1970 and projected 1980, 2000, and 2020

Year and Subarea	Agriculture	Mining	Contract construction	Manufacturing	Transportation and public utilities	Wholesale and retail trade	Finance, insurance, and real estate	Services	Government	Total
	Number									
1970										
Yazoo Delta	21,890	1,059	6,708	26,950	6,590	19,183	2,354	28,951	4,001	117,686
Yazoo Bluff	5,506	266	1,687	6,779	1,658	4,825	592	7,282	1,006	29,601
Yazoo Hill	10,171	492	3,117	12,523	3,062	8,914	1,094	13,453	1,859	54,685
Basin	37,567	1,817	11,512	46,252	11,310	32,922	4,040	49,686	6,866	201,972
1980										
Yazoo Delta	14,073	896	8,188	31,088	7,676	21,877	2,815	35,693	5,629	127,935
Yazoo Bluff	3,471	221	2,020	7,668	1,893	5,396	694	8,804	1,388	31,555
Yazoo Hill	6,410	408	3,729	14,159	3,496	9,964	1,282	16,257	2,564	58,269
Basin	23,954	1,525	13,937	52,915	13,065	37,237	4,791	60,754	9,581	217,759
2000										
Yazoo Delta	10,925	898	9,728	39,510	8,381	25,891	3,891	42,802	7,633	149,659
Yazoo Bluff	2,695	221	2,400	9,746	2,067	6,386	960	10,558	1,883	36,916
Yazoo Hill	4,873	401	4,339	17,623	3,738	11,548	1,736	19,091	3,404	66,753
Basin	18,493	1,520	16,467	66,879	14,186	43,825	6,587	72,451	12,920	253,328
2020										
Yazoo Delta	10,678	736	11,967	48,237	10,126	31,851	5,339	54,497	10,678	184,109
Yazoo Bluff	2,634	182	2,952	11,898	2,498	7,857	1,317	13,443	2,634	45,415
Yazoo Hill	4,763	328	5,338	21,515	4,517	14,207	2,381	24,307	4,763	82,119
Basin	18,075	1,246	20,257	81,650	17,141	53,915	9,037	92,247	18,075	311,643

Source: Adapted from 1972 OBERS Projections, U. S. Water Resources Council, Washington, D. C.

201,972 persons employed in the basin in 1970, as compared with 243,701 in 1950 and 208,514 in 1960. These values reflect a decrease in employment of 14.4 percent between 1950 and 1960, and a decrease of 3.1 percent from 1960 to 1970.

The decrease during the 1950 to 1970 period reflects the loss of employment as agriculture, a traditionally labor-intensive industry, adopted more mechanized methods. Agricultural employment declined from 138,966 in 1950 to 37,567 in 1970. The technological strides in agriculture contributed to losses in agricultural employment that were not offset by increased employment in other industries. The influx of manufacturing into the basin during the 1960 to 1970 period, accompanied by a lessening in agricultural employment losses, will result in a reversal of the downward trend in total employment between 1970 and 1980.

In 1960, agriculture and manufacturing, the two most important major water-using industries as regards employment in the basin, accounted for 36.3 and 12.7 percent, respectively, of total employment. Agricultural employment declined from 75,588 in 1960 to 37,567 in 1970, a decrease of 50.3 percent. Manufacturing employment, in contrast, increased 75.1 percent from 26,415 to 46,252.

As indicated by the data in table 3.2, the downward trend in total employment is expected to bottom out in the 1970's. Thereafter, there should be an increase in total employment. All industries except agriculture and mining will experience employment gains between 1970 and 2020. In future years, the employment base will become more diversified, the migration of population will be halted, and personal and per capita income will increase.

Personal Income

Total personal income is that received by residents of the basin from all sources, inclusive of transfers from government and business but exclusive of transfers among persons. It is income received before taxes and includes allowances for nonmonetary income or income received "in kind" rather than cash. It consists of wage and salary disbursements, other labor income, proprietors' income, property income, and transfer payments, less personal contributions for social insurance.

Personal income accruing to basin residents amounted to approximately $1.1 billion in 1970, an increase of 75 percent above that in 1960. The trends in personal income payments and the relative importance of each subarea in the Yazoo-Mississippi River Basin are shown in table 3.3.

Table 3.3. Personal income by subareas, Yazoo-Mississippi River Basin, 1960 and 1970, and projected 1980, 2000, and 2020

Sub-area	1960	1970	1980	2000	2020
	Dollars				
Yazoo Delta	416,952,096	657,083,070	945,021,462	2,137,437,370	4,894,596,252
Yazoo Bluff	88,714,732	160,996,550	232,191,024	525,246,144	1,292,789,790
Yazoo Hill	140,339,764	309,730,217	421,838,340	934,367,899	2,139,626,178
Basin	646,007,592	1,127,809,837	1,599,050,826	3,597,051,413	8,237,012,220

Source: Adapted from 1972 OBERS Projections, U. S. Water Resources Council, Washington, D. C.

Twenty-six percent of the basin income was generated by the agricultural sector, 23 percent by the manufacturing sector, and 51 percent from all other industry groups in 1970. In past years, the principal source of personal income has been from agriculture but in future years the principal source will be from manufacturing and services.

Per Capita Income

Per capita income for the basin increased 89.4 percent between 1960 and 1970 (table 3.4). The per capita income gains by subareas were: Yazoo Delta, 87.1 percent; Yazoo Bluff, 91.6 percent; and Yazoo Hill, 109.3 percent. The estimated increase in basin per capita income between 1970 and 1980 is 38.8 percent. The per capita income gains for the subareas from 1970 to 1980 are estimated to be: Yazoo Delta, 39.7 percent; Yazoo Bluff, 42.8 percent; and Yazoo Hill, 34.9 percent. The per capita income gain of each subarea is estimated to approximate 98.4 percent between 1980 and 2000, and 90.9 percent between 2000 and 2020.

The per capita income of the basin has historically been below the national average. This relationship to the national average increased from 43.5 in 1960 to 58.8 percent in 1970. By 1980 basin per capita income will be 58.6 percent of the national average, 66.8 percent in 2000, and 74.1 percent in 2020.

Table 3.4. Per capita income by subareas, Yazoo-Mississippi River Basin, 1960 and 1970, and projected 1980, 2000, and 2020

Subarea	Year 1960	1970	1980	2000	2020
	1967 Dollars				
Yazoo Delta	1,104	2,010	2,807	5,570	10,634
Yazoo Bluff	1,022	1,958	2,796	5,549	10,594
Yazoo Hill	974	2,039	2,751	5,459	10,422
Basin[1] (wt.avg.)	1,061	2,010	2,790	5,537	10,572

Source: Adapted from 1972 OBERS Projections, U. S. Water Resources Council, Washington, D. C.

1/ Weighted per capita for basin used in analysis.

Agriculture and Related Economic Activity

An appraisal of agricultural and related economic activity is basic to wise and constructive planning of the competitive use of resources. The Yazoo-Mississippi River Basin is highly dependent upon agriculture as a means of providing a livelihood for its inhabitants, whether it be from actual production of goods or to firms supplying goods and services to farm operators. Agriculture is a basic industry. The basin specializes and produces goods and services which are sold to other areas and thus earns the means to purchase specialized goods and services produced in other areas.

National Production Requirements

The national food and fiber production requirements were developed to support a national population of 234 million in 1980, 307 million in 2000, and 399 million in 2020. The projected requirements represent a need for the expected demand under the specified assumptions presented earlier. The requirements were adjusted to account for imports and exports. Consequently, the end result is the amount of agricultural products that will need to be produced to supply domestic requirements in the United States and to allow for projected exports. Projected national requirements for major crops, livestock products, and industrial timber products are presented in table 3.5.

Table 3.5. Agricultural and forestry production by commodity groups, United States, 1964, and projected 1980, 2000, and 2020 1/

Commodity	Units	1964	1980	2000	2020
Crops		- - - - - -	-Thousands-	- - - - - -	- - - - - -
Wheat	Bushels	1283394.4	1514186.6	1811685.3	2052783.2
Rye	Bushels	32593.3	29775.6	31346.2	32928.6
Rice	Cwt.	73165.5	98198.9	115798.7	137798.2
Corn for grain	Bushels	3544176.2	6293579.8	7707343.5	9391418.3
Silage	Tons	107239.4	136697.9	166097.2	202497.2
Grain sorghum	Bushels	489785.0	1159368.5	1484159.7	1836750.9
Oats	Bushels	851812.4	852484.6	880483.1	912783.3
Barley	Bushels	386054.5	504194.5	629293.3	738991.5
Fruits and nuts	Tons	17455.4	24599.1	31900.2	40700.6
Vegetables	Cwt.	374658.7	540090.8	702086.7	910282.7
Hay	Tons	118776.9	130397.9	160797.7	197697.6
Soybeans	Bushels	700915.7	1504982.3	1858277.5	2187975.9
Flaxseed	Bushels	24352.8	26999.9	22999.9	20999.6
Peanuts	Pounds	2099131.2	4112356.0	5328644.9	6670827.3
Cotton	Bales	15183.2	11499.9	12499.7	13499.7
Sugarcane	Tons	13821.9	28211.3	31421.2	34609.1
Sugarbeets	Tons	23112.7	23699.7	37699.8	55299.8
Tobacco	Pounds	2227324.6	1997983.6	2303881.0	2602979.2
Irish & sweet potatoes	Cwt.	253578.1	344998.1	447197.4	577897.8
Dry beans & dry peas	Cwt.	22255.4	27199.9	32199.5	37599.3
Livestock					
Beef & veal	Pounds	34785073.1	50462277.6	67947722.4	91274581.9
Pork	Pounds	20204529.7	25388390.3	33250152.1	43055404.4
Lamb and mutton	Pounds	1330160.1	1001090.2	1178288.1	1407985.9
Chickens	Pounds	8681245.8	16014104.3	22364250.8	30028409.4
Turkeys	Pounds	1822172.1	3164174.1	4446958.5	6004544.2
Eggs	Dozens	5418383.9	6313858.9	8086816.8	10247699.7
Milk	Pounds	126810000.0	111902200.0	138166000.0	168786600.0
Timber 2/					
All Roundwood	Cu. Ft.	10243000.0	19080000.0	29120000.0	34600000.0
Sawlogs, veneer logs and other Industrial products	Cu. Ft.	6577000.0	11770000.0	16100000.0	18100000.0
Pulpwood	Cu. Ft.	2542000.0	6440000.0	12160000.0	15660000.0

Source: 1972 OBERS Projections, U. S. Water Resources Council, Washington, D.C.

1/ Crop, livestock, and timber production is exclusive of Alaska and Hawaii.

2/ 1962 timber production is reported under 1964.

Yazoo-Mississippi Basin Production Requirements

A part of the future national production requirements for agricultural products is expected to accrue from the basin. The difference between present output in the basin and projected requirements for agricultural products when translated into land provides a guide to the needs for development of land and water resources.

Total agricultural output in the basin is projected to increase in the aggregate but for some individual commodities a decrease in output and resulting resource use will occur. The projected output is the requirement of the basin to meet its share of state and national requirements including exports (table 3.6).

The basin is important in the production of row and close-seeded crops. The estimated production accruing from the three land resource areas in the basin is presented in table 3.7. LRA 131 accounts for the majority of the cotton, sorghum grain, oats, rice, wheat, and peanuts that is produced.

Cotton - The most important cash crop grown in the basin is cotton. Up until about 1950, cotton accounted for 50 percent or more of total harvested acreage. By the mid 1950's, the percentage had declined to less than 50 percent as the planting and harvesting of soybeans increased in importance. In the mid 1960's, the harvested acreage of soybeans surpassed cotton. The projections indicate that soybeans will be first and cotton second in terms of acreage during the 50-year projection period.

Although cotton has been replaced by soybeans in terms of acres, the crop marketing receipts derived from sales of cotton lint and cottonseed are still first in importance. The projections indicate that cotton marketing receipts will maintain its supremacy through about 1990. After that time, soybean marketing receipts will account for the largest share of total crop marketing receipts in the basin.

Approximately 831 thousand acres of cotton were harvested in 1970. The projected acreages for without and with project conditions are presented in table 3.8. The decline in acreage is more than offset by increasing yields with a resulting increase in total cotton production over and beyond the 1970 level of output. Projected production is 1.1 million bales in 1980, 1.2 million bales in 2000, and 1.3 million bales in 2020.

Soybeans - In terms of crop marketing receipts, soybeans are second only to cotton in the basin. In terms of acres harvested, soybeans are number one. The acres of soybeans harvested surpassed cotton in the mid 1960's. Acreage increased from about 247 thousand acres in 1949 to approximately 1.1 million acres in 1964.

Table 3.6. Agricultural and forestry production by commodity groups, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Commodity	Units	1970	1980	2000	2020
		Thousands			
Crops					
Wheat	Bushels	3,761.6	9,261.5	13,294.7	15,924.9
Rice	Bushels	4,986.7	6,315.8	8,665.3	11,202.2
Corn	Bushels	1,948.0	1,807.7	416.0	98.7
Silage	Tons	455.3	440.4	602.1	772.3
Oats	Bushels	2,407.9	1,927.8	1,389.9	1,004.7
Vegetables	Cwt.	229.6	192.0	124.2	81.8
Fruit and nuts	Tons	1.5	.9	.8	.7
Hay	Tons	192.6	187.9	220.5	256.9
Soybeans	Bushels	38,466.8	59,068.8	84,114.4	96,296.6
Cotton	Bales	1,246.5	1,083.5	1,229.6	1,348.9
Irish potatoes	Cwt.	56.1	26.8	9.4	3.5
Sweet potatoes	Cwt.	310.0	266.8	283.6	366.3
Peanuts	Pounds	500.0	372.7	156.6	65.4
Grain sorghum	Bushels	185.5	4,657.4	7,722.9	10,685.6
Livestock					
Beef and veal	Pounds	131,096.8	260,651.1	388,832.0	555,142.2
Pork	Pounds	30,691.1	41,135.3	38,065.6	35,015.4
Lamb and mutton	Pounds	158.8	95.2	45.4	21.7
Chickens	Pounds	3,129.4	7,840.1	12,075.7	18,538.0
Broilers	Pounds	17,731.3	40,362.4	60,969.0	84,825.6
Turkeys	Pounds	92.3	127.9	37.4	10.1
Eggs	Dozens	17,960.7	33,969.6	53,715.3	75,394.1
Milk	Pounds	165,307.3	146,077.0	132,525.2	119,638.5
Timber					
All roundwood	Cu. Ft.	66,000.0	86,000.0	117,000.0	138,000.0
Sawlogs, veneer logs and other industrial products	Cu. Ft.	42,000.0	66,000.0	76,000.0	88,000.0
Pulpwood	Cu. Ft.	24,000.0	20,000.0	41,000.0	50,000.0

Source: Historical crop and livestock data from Statistical Reporting Service adjusted to hydrologic boundary. Timber data from Forest Survey. Projections adapted from 1972 OBERS.

Table 3.7. Estimated crop production accruing from specified land resource areas, Yazoo-Mississippi River Basin, 1970

Crop	LRA 131 1/	LRA 133 2/	LRA 134 3/	Total
	Percent	Percent	Percent	Percent
Cotton	71.9	8.4	19.7	100.0
Corn	13.3	44.2	42.5	100.0
Sorghum grain	72.4	3.7	23.9	100.0
Oats	81.6	.4	18.0	100.0
Rice	95.7	0	4.3	100.0
Irish potatoes	24.0	18.2	57.8	100.0
Sweet potatoes	5.3	73.5	21.2	100.0
Wheat	97.3	.2	2.5	100.0
Peanuts	63.3	13.3	23.4	100.0
Hay	27.1	27.9	45.0	100.0
Soybeans	82.0	2.5	15.5	100.0

Source: Crop production data based on Census of Agriculture and summed by counties comprising land resource areas as defined in Water Resource Regions and Subregions for the National Assessment of Water and Related Land Resources, Water Resources Council, Washington, D. C., p. 96.

1/ Southern Mississippi Valley Alluvium.
2/ Southern Coastal Plain.
3/ Mississippi Valley Silty Uplands.

Approximately 1.6 million acres were harvested in 1970. The projected acreages for without and with project conditions are presented in table 3.8. Like cotton did until the mid 1960's, soybean acreage does now and will in the future account for over 50 percent of total harvested acreage in the basin.

Production is projected to be about 59 million bushels in 1980, 84 million bushels in 2000, and 96 million bushels in 2020 (table 3.6). It is anticipated that yields will more than double between 1970 and 2020.

The future for soybeans in the basin should be profitable to growers. They will benefit by proven production methods, orderly marketing, and increasing product utilization.

Corn - Up until 1949, corn was the second most important crop in terms of harvested acreage in the basin--cotton being first. It was replaced by soybeans in the early 1950's and by 1959 stood third in terms of crop marketing receipts, cotton and soybeans were number one and two.

Table 3.8. Harvested acreage of specified crops, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020 -- without and with development

Crop	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
	Without development 2/			
Soybeans	1,602,800	2,036,900	2,474,000	2,407,400
Cotton	831,000	779,500	793,300	793,500
Wheat	125,400	250,300	309,200	318,500
Grain sorghum	3,700	105,800	135,500	161,900
Rice	51,700	60,200	71,600	81,200
Oats	43,000	37,100	23,600	15,200
Corn	39,000	34,800	5,900	1,300
Other 1/	274,100	308,100	320,000	345,500
Total	2,970,700	3,612,700	4,133,100	4,124,500
	With development 2/			
Soybeans	1,602,800	1,905,400	1,869,200	1,925,900
Cotton	831,000	573,300	614,800	602,200
Wheat	125,400	225,900	277,000	269,900
Grain sorghum	3,700	84,700	118,800	140,600
Rice	51,700	55,900	61,900	70,000
Oats	43,000	34,400	21,700	12,600
Corn	39,000	27,800	5,100	1,000
Other 1/	274,100	308,100	320,000	345,500
Total	2,970,700	3,215,000	3,288,500	3,367,700

Source: Translated from production data in table 3.6.

1/ Includes silage, vegetables, fruit and nuts, hay, Irish potatoes, sweet potatoes, and peanuts.

2/ See Chapter VII for without and with development rationale.

There has been a drastic decline in corn acreage. Acreage declined from approximately 690 thousand acres in 1949 to 39 thousand acres in 1970. While some corn entered the marketing channel as grain, most was used on farms for livestock feeding and human consumption. With the adoption of mechanized farming methods and the elimination of workstock from farms and plantations, corn production has virtually vanished.

Projected corn acreages for without and with project conditions are presented in table 3.8. Production is projected to be about 1.8 million bushels in 1980, 416 thousand bushels in 2000, and 99 thousand bushels in 2020 (table 3.6).

Rice - Modern rice farming was extended to the delta portion of the basin immediately following World War II. In the absence of acreage control, production expanded rapidly. The acreage increased from about 7 thousand acres in 1949 to 74 thousand acres in 1954. In 1959, rice allotments totaled about 45 thousand acres and in 1970 about 52 thousand acres.

This relatively new enterprise has emerged as a substantial source of income for the basin. Currently, rice receipts rank third in importance and will maintain this position throughout the 50-year projection period.

Projected rice acreages for without and with project conditions are presented in table 3.8. Production is projected to be 6.3 million bushels in 1980, 8.7 million bushels in 2000, and 11.2 million bushels in 2020 (table 3.6).

Wheat - The production of wheat in past years has been relatively insignificant. Approximately 6.5 thousand acres were harvested in 1949 and there has been an erratic upward trend since then with approximately 125.4 thousand acres being harvested in 1970.

Projected wheat acreages for without and with project conditions are presented in table 3.8. The projections indicate that wheat will be third in terms of acreage during the 50-year projection period.

Production is projected to be 9.3 million bushels in 1980, 13.3 million bushels in 2000, and 15.9 million bushels in 2020 (table 3.6). Receipts from wheat marketings will rank fourth in importance behind cotton, soybeans, and rice during the next 50 years.

Grain sorghum - In past years the production of grain sorghum in the basin has been a minor crop enterprise. During the period 1949 to 1970, acreage harvested ranged from a low of 2.5 thousand acres in 1949 to a high of 15 thousand acres in 1959. Approximately 3.7 thousand acres were harvested in 1970.

Projected grain sorghum acreages for without and with project conditions are presented in table 3.8. Sorghum will be the fourth most important crop in terms of acreage during the projection period.

Production is projected to be 4.7 million bushels in 1980, 7.7 million bushels in 2000, and 10.9 million bushels in 2020 (table 3.6). Sorghum will be the fifth most important crop in terms of marketing receipts during the projection period.

Oats - Acreage and production have fluctuated widely since 1949. Approximately 70 thousand acres were harvested in 1949, 238 thousand acres in 1954, 146 thousand acres in 1959, and 43 thousand acres in 1970. The trend is downward, however, in terms of harvested acreage.

Projected oat acreages for without and with project conditions are presented in table 3.8. Production is projected to be 1.9 million bushels in 1980, 1.4 million bushels in 2000, and 1.0 million bushels in 2020 (table 3.6).

Beef and veal - The basin is predominately a crop producing area. However, the basin contains more cattle and calves than any other subbasin in the Lower Mississippi Region.

There is a definite upward trend in cattle and calf numbers in the basin. There were approximately 377 thousand head of cattle and calves on farms in 1949 and approximately 741 thousand in 1970. The trend is expected to continue upward through 2020 as portrayed by the net liveweight production figures presented in table 3.6.

The basin is in a relatively good competitive position in the production of grass-fed cattle. Some limited grain feeding operations now prevail and this practice is anticipated to grow in importance. Grain storage facilities presently appear adequate.

Pork - The number of hogs and pigs on farms declined from about 383 thousand head in 1949 to about 182 thousand in 1970. Basically this trend has followed the trend in farm numbers and also the downward trend in corn production.

The projections indicate that net liveweight production will show a slight increase between 1970 and 1980 and then turn downward again through the year 2020 (table 3.6).

Lamb and mutton - The production of lamb and mutton is a relatively minor livestock enterprise. National future requirements indicate that the State of Mississippi and the basin will contribute only a meager portion. With other changes and adjustments being made in the basin's agriculture, it is anticipated that sheep and lamb production will do no more than hold its own in the future as indicated by the data in table 3.6.

Chickens - This poultry enterprise includes those birds four months old and over and represents mostly commercial laying hens. There has been a relatively constant number of chickens on farms during the period 1949-1970, averaging about 2 million birds. About 2.1 million chickens were estimated to be on farms in 1970. The projections indicate that this enterprise will continue to grow during the projection period and provide an increasing amount of farm income.

Broilers - The production of broilers was virtually nonexistent in the basin prior to 1950. In 1954, approximately 1.1 million birds were marketed. Production increased rapidly and approximately 5.9 million birds were marketed in 1970.

Increased marketings are expected to prevail in future years. The projected liveweight volumes are 40.4 million pounds in 1980, 61.0 million pounds in 2000, and 84.8 million pounds in 2020.

Turkeys - This is a relatively minor poultry enterprise. A limited number of turkeys are raised and consequently a limited output and a small contribution to gross farm income.

Net liveweight production is projected to be 127.9 thousand pounds in 1980, 37.4 thousand pounds in 2000, and only 10.1 thousand pounds in 2020 (table 3.6).

Eggs - Production has been expanding in recent years and this trend is expected to continue. The early development of egg production was as a sideline enterprise on many farms. In recent years, a new commercial egg industry has emerged.

Egg producers have adopted new and emerging production and marketing practices. In particular, producers have been receptive to cost-reducing changes and have achieved a high degree of coordination of production, input-supplying, and marketing. The willingness of entrepreneurs to adopt new systems in future years will enhance their competitive position.

Projected marketings are 34.0 million dozen in 1980, 53.7 million dozen in 2000, and 75.4 million dozen in 2020 (table 3.6).

Milk - There is a definite downward trend in the production of whole milk. Production amounted to about 331 million pounds in 1954, 290 million pounds in 1959, 220 million pounds in 1964, and 165 million pounds in 1970.

The projections indicate that only 146.1 million pounds will be produced in 1980, 132.5 million pounds in 2000, and 119.6 million pounds in 2020 (table 3.6).

Farm Income

Farm income is that received in cash and non-monetary allowances. It consists of four major components: farm marketings, home consumption of farm-produced products, rental value of farm dwellings, and government transfer payments.

Basin farm marketing receipts totaled $499.8 million and are the principal component of farm income (table 3.9). Crops dominate farm marketing receipts in the basin. Crop marketing receipts approached $450 million in 1970 or 90 percent of total farm marketing receipts. Field crops are the number one source of receipts followed by forestry and horticulture crops. Vegetables and fruit and nuts share about equally as a source of farm receipts.

In 1970, some $50 million worth of livestock, dairy, and poultry products were sold. This is more than double the receipts from the same source in 1949.

Farm Structure

A tremendous reorganization in agriculture has taken place in the last few decades. A rapid technological advance has greatly increased farm output in spite of a sharp decline in the amount of labor employed on farms and a slight decrease in the total number of acres in farms. Specialization and commercialization in the production of farm products have been greater during the last 20 years than during any other comparable period.

Output per farmworker has expanded faster than the demand for farm products, with the result that fewer farm operators are needed to produce the required farm products. Consequently, farm operators seek to make adjustments in their operations that will permit them to remain in business. Many of the adjustments have involved expansion of farm size and change in tenure status.

Table 3.9. Gross income, production expenses, and net income, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Item	1970	1980	2000	2020
	Thousand Dollars			
Receipts				
Farm marketings	499,785	684,465	790,708	898,633
Other 1/	81,360	111,425	128,720	146,289
Total gross income 2/	581,145	795,890	919,428	1,044,922
Total production expense	406,802	557,123	643,600	731,445
Net income	174,343	238,767	275,828	313,477

Source: Economic Research Service, United States Department of Agriculture.

1/ Includes value of home consumption of farm products, value of farm dwellings, and government transfer payments.

2/ Excludes changes in inventories.

Farms - The economic structure of American agriculture has become so complex that a better understanding of the number, kinds, and sizes of farms is much needed as background for an effective analysis of resource planning. The growing frequency of residential units in agriculture as well as the effects of mechanization and other technological development on the number and size of farm make it increasingly difficult to think in terms of aggregates or an overall average farm.

There has been a drastic decline in the number of basin farms. Over a 20-year span farms have declined 80 percent. In 1969 there were 19,422 farms in the basin or 77,622 less than in 1949 (table 3.10). Conversely, the average size of farm increased from 88 acres in 1949 to 335 acres in 1969, or an increase of 281 percent. It is noteworthy that although basin farms have drastically declined, total production of agricultural products has increased both in terms of physical quantities and gross marketing receipts.

Farm numbers have declined in all subareas of the basin. Farms in the Yazoo-Delta declined from 57,432 in 1949 to 7,090 in 1969. In the Yazoo-Bluff, the number declined from 13,793 in 1949 to 3,728 in 1969. In the Yazoo-Hill, the number declined from 25,819 in 1949 to 8,604 in 1969.

Table 3.10. Number and size of farms, Yazoo-Mississippi River Basin and its subareas, 1949, 1954, 1959, 1964, and 1969

Subarea	Unit	1949	1954	1959	1964	1969
Yazoo Delta						
Farms	Number	57,432	45,108	19,857	12,249	7,090
Size of farm	Acres	80	97	186	287	466
Yazoo Bluff						
Farms	Number	13,793	11,612	7,461	5,747	3,728
Size of farm	Acres	100	114	163	204	289
Yazoo Hill						
Farms	Number	25,819	21,957	15,447	12,166	8,604
Size of farm	Acres	89	99	122	152	200
Basin						
Farms	Number	97,044	78,677	42,765	30,162	19,422
Size of farm	Acres	88	102	161	222	335

Source: Census of Agriculture, United States Department of Commerce.

It is likely that the number of farms will continue to decline in the basin and subareas, but at a reduced rate. Delta farms are characterized by highly fertile soils and the use of mechanical power and equipment on vast expanses of fairly level land. Farmers in the Bluff and Hill subareas are less fortunate, and therefore the operators are turning more to livestock and poultry. In addition, the operators are acquiring off-farm jobs to supplement their farm income while maintaining the farm as a place of residence.

Farms by Size - Of the 19,422 farms in the basin in 1970, 32 percent were 10 to 49 acres in size. There is a downward trend in the number of smaller size farms through the size category 260 to 499 acres. Farms containing 500 acres or more are increasing.

Farms by Type - The type of farm represents a description of the major source of income from farm sales. To be classified as a particular type, a farm has to have sales of a particular product or group of products amounting to 50 percent or more of the total value of all farm products sold during the year.

Most of the basin farms are the field crop type-cotton dominating. The second most important type is miscellaneous farms and the third is livestock.

Land in Farms - Basin land in farms was approximately 6.3 million acres in 1969 or 7 percent less than in 1954 (table 3.11). This demonstrates the extent to which farm operators control a sizeable majority of the land resources in the basin.

Table 3.11. Farm land use, Yazoo-Mississippi River Basin, selected years, 1954-1969 1/

Land Use	1954	1959	1964	1969
	-Acres-			
Cropland	3,515,777	3,411,972	3,358,135	3,640,000
Pasture	871,124	833,990	1,025,693	943,000
Forest	2,039,868	1,810,649	1,631,349	1,459,135
Other	315,830	349,967	316,026	229,857
Total	6,742,599	6,406,578	6,331,203	6,271,992

Source: Census of Agriculture, United States Department of Commerce. Data adjusted to hydrologic boundaries.

1/ These data are for land in farms and are not comparable to CNI data.

The farm land base is declining and will continue to decline; however, further reductions are not expected to be drastic. As the basin becomes more industrialized and increases in population, more space will be needed for residential, commercial, industrial, and public uses.

Economic Class of Farms - The economic classification of farms is divided into commercial and noncommercial farms. Most basin farms are commercial -- namely, they derive most, if not all, of their income from the farm business. Approximately 27 percent of basin farms are noncommercial. These farms are primarily part-time and part-retirement farm operations.

Most of the commercial farms and the ones with high gross incomes are situated in the Yazoo-Delta subarea. A larger percentage of the low income commercial farms are located in the Yazoo-Bluff and Yazoo-Hill subarea. Also, part-time and part-retirement farms are more prevalent in these two subareas than in the Yazoo-Delta.

Tenure - Farm tenure deals with the respective rights of individuals in the use of land and resources associated with the land required in agricultural production. The tenure arrangements under which farmland is operated may affect the way the land is used and the amounts of capital and labor used with the land. Thus, the tenure arrangement under which farmland is operated affects the total agricultural production, farm income, and the status of farm families.

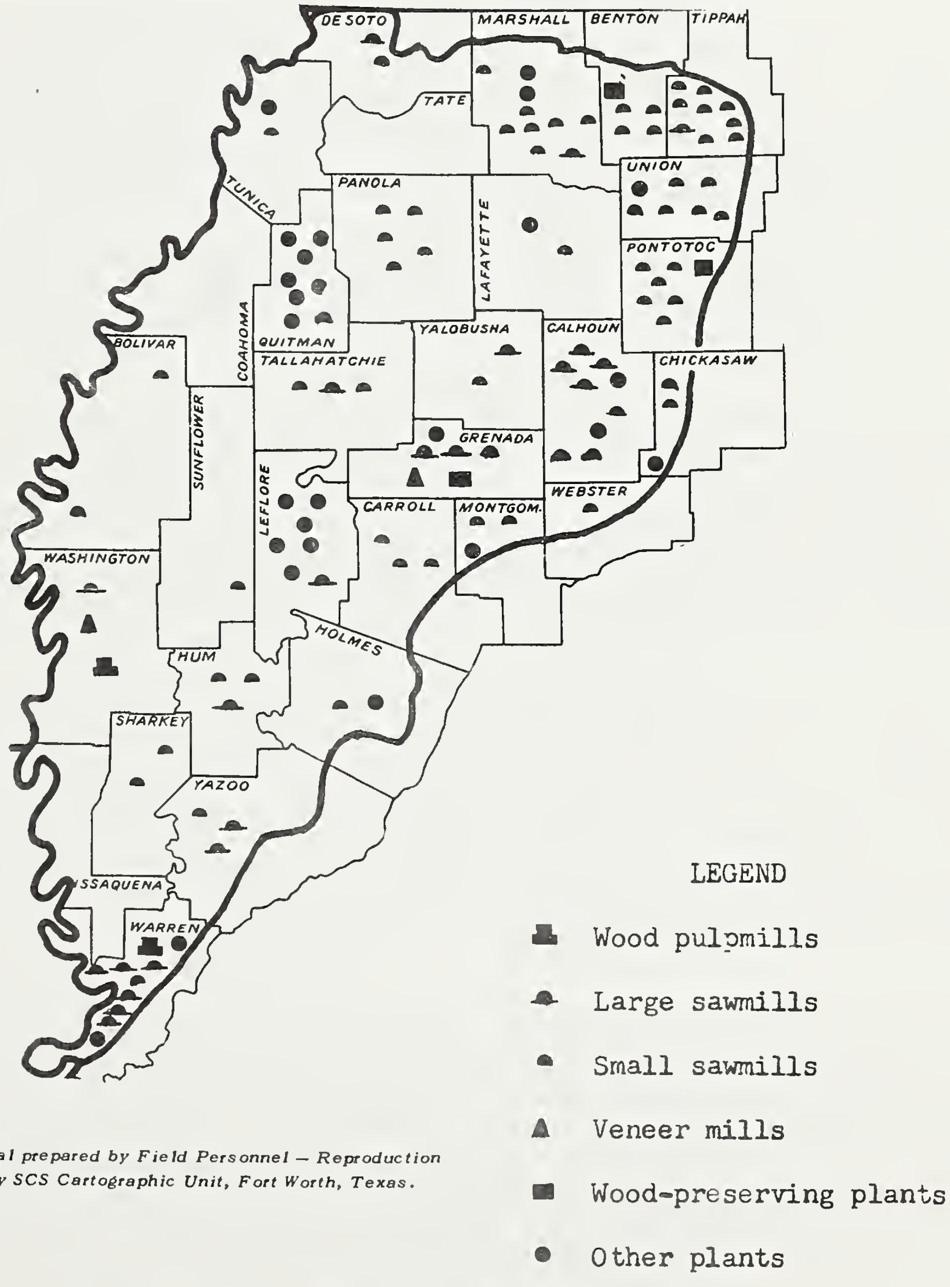
In 1969, 62 percent of basin farms were operated by full owners, 24 percent by part-owners, and 14 percent by tenants. Farms operated by tenants predominated through 1959. Full owners presently predominate and part-owners are increasing steadily.

Forest Economy

In 1970, Mississippi was the South's third leading state in pulpwood production. Location of two pulp mills in the basin represents one-fifth of the total capacity of the state. Other forest industries include 80 sawmills, 3 wood preserving plants, 3 veneer plants, and 24 miscellaneous wood using plants (map 3.1).

Of the state's total industrial roundwood production, 13 percent accrues from the basin which contains 23 percent of the commercial forest land. Both hardwood growing stock and sawtimber volumes were removed in 1970 at twice the rate of removal for the entire state. Yet, hardwood growing stock in the last five years has increased at a greater rate than for the state. Softwood sawtimber volume has increased at a slightly less rate. These softwood volume increases are attributed to the establishment of vast areas of pine plantations and the application of timber stand improvement.

Map 3.1: Location of primary wood-using plants, Yazoo-Mississippi River Basin, 1970



Material prepared by Field Personnel — Reproduction only by SCS Cartographic Unit, Fort Worth, Texas.

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In 1967, approximately 30,400 employees in forest industries in the basin earned about $114 million. Payments to stumpage growers totaled about $30 million to the basin's economy. The added $129 million in new capital expenditures raises the annual contributions to the basin's economy to $273 million. Eighty percent of all capital expenditures for forest industry in the basin went to pulp mills.

When wage earners and stumpage sellers spend this income, additional jobs and incomes are created. The value added by timber is approximately 22 times the stumpage value. The $30 million stumpage sales of 1970 generated $660 million in economic activity through processing, marketing, transportation, and construction. Hardwood sawtimber stumpage accounted for $16.2 million, pine sawtimber for $6.7 million, hardwood pulp for $5.3 million, and pine pulp for $1.8 million.

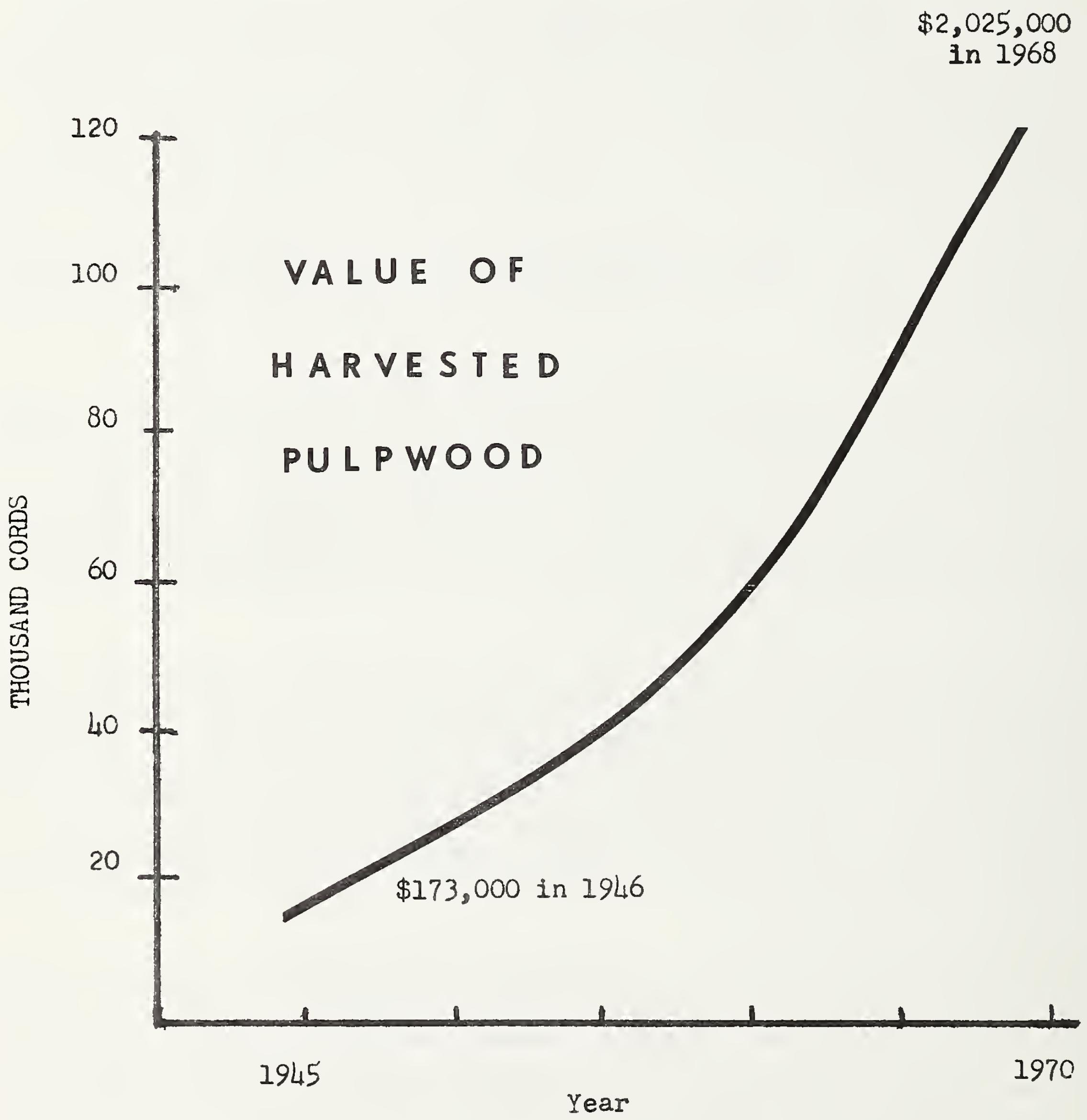
Midsouth pulpwood stumpage prices have increased 35 percent in the last ten years. Chipped residues during the same period increased 23 percent. Pine sawtimber stumpage prices increased 30 percent over the past three years.

The Yazoo-Little Tallahatchie Flood Prevention Project has a substantial economic impact on the upland area of the basin. The results have been substantially increasing the value of a pulpwood crop of $173 thousand in 1946 to $2.0 million in 1968 (figure 3.1). Currently timber harvests, through primary and secondary phases, contributes $95.5 million to Mississippi's economy as well as contributing to the quality of life through recreation, wildlife, and other environment benefits relating to the forest resource.

Historically, the growth of the forest industry, both in the state and in the basin, has been impressive. Pulp and softwood plywood manufacturers have been the leading performers for the state. The basin will continue to furnish the Memphis hardwood market with substantial volumes of quality hardwood products even though the capacity to produce is decreasing. Softwood plywood industries have located mostly in the southern part of the state. However, one pine plywood plant has recently located in the basin with the advent of more to come as the softwood growing stock increases.

The forest sector has contributed substantially to improved incomes. Southern forest industries had a better productivity record from 1950 to 1969 than the national industry, permitting wages to rise faster than the national average. The paper industry, which pays high wages and has grown rapidly in the South, has provided a strong boost to employment and incomes in rural areas. The decline of employment in the low-wage lumber industry has reduced the number of low-paying jobs for unskilled workers, but productivity gains have permitted rapid rises in wages.

Figure 3.1: Value of harvested pulpwood within the Yazoo-Little Tallahatchie Flood Prevention Project area, 1946 through 1968



The basin has not depended heavily upon forestry to support its total economy. Forestry, fishery, lumber, and furniture earnings represented 2.8 percent of total earnings in 1950, 2.9 percent in 1962, 3.7 percent in 1967, and 4.0 percent in 1968.

The OBERS projections indicate an 18 percent decline in forest acreage from 3.2 million acres in 1970 to 2.0 million acres by the year 2020. This forest acreage will be largely converted to cropland on the productive bottomland hardwood sites. Forest acreage loss in upland will probably be replaced by pasture.

Forest roundwood projections indicate a 110 percent increase in demand from 66 million cubic feet in 1970 to 138 million cubic feet by 2020 (figure 3.2). About 1980, demand will exceed supply. This trend will create a demand-supply deficit of 19 cubic feet per acre by the year 2020 (figure 3.3).

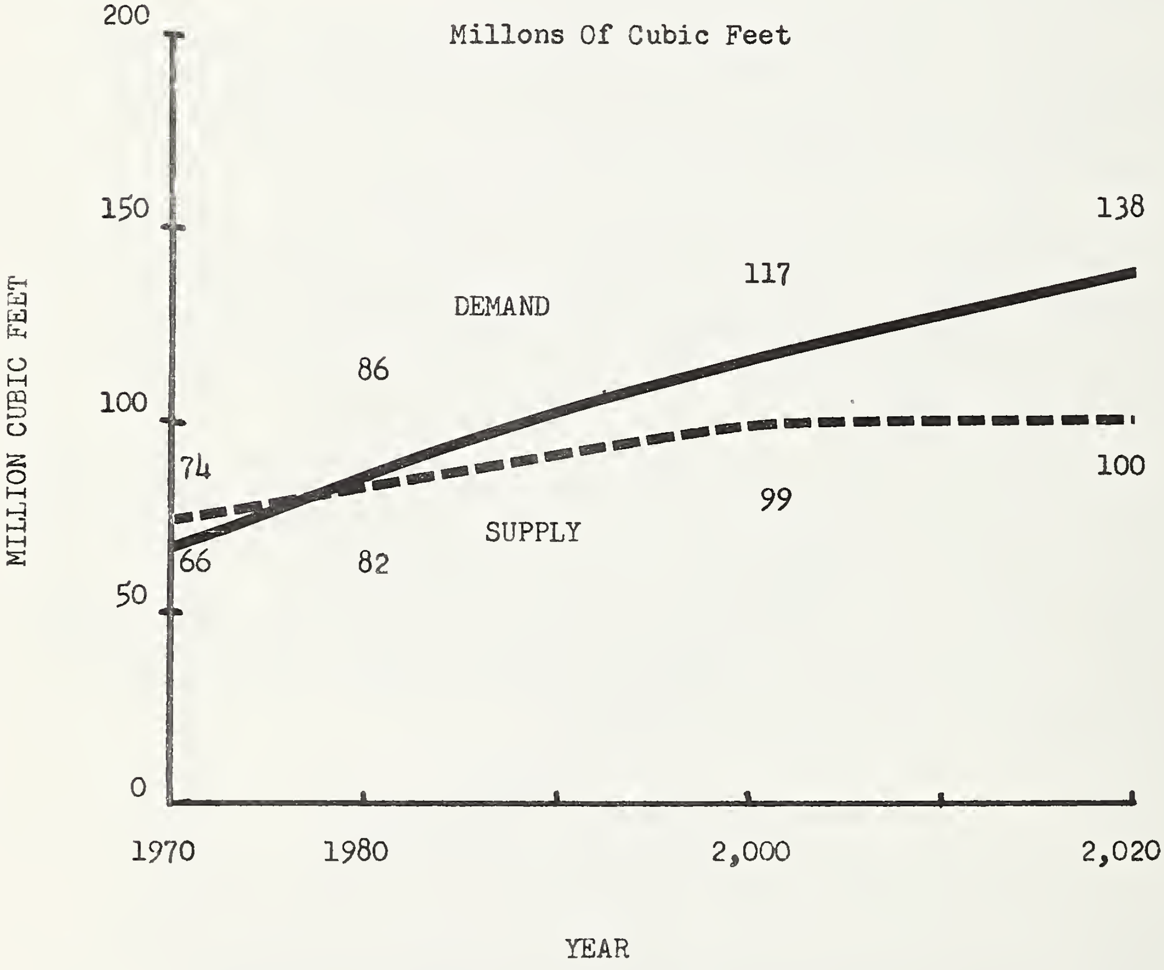
Present net growth of softwoods in the state exceeds removals by only 6 percent. In 1966, the margin of timber growth over cut was 10 times as great. This trend in the coming years will affect the volume of forest products available for industrial expansion. Treatment of understocked stands could produce greater volumes of wood to meet future demands.

Growth potential is 86.0 cubic feet per acre. Current growth is only 44 cubic feet per acre or 51 percent of its potential. This growth is projected to increase to 55 cubic feet per acre, or 64 percent of its potential by 2020 under current management trends (figure 3.4). If all growth is removed by year 2020 only about 80 percent of the demand will be met. Demand exceeds supply but growth potential exceeds demand. This means that if forest management practices are intensified, projected growth would increase and demand for 2020 could be met on the projected forest acreage base.

Economic Importance of Fish and Game

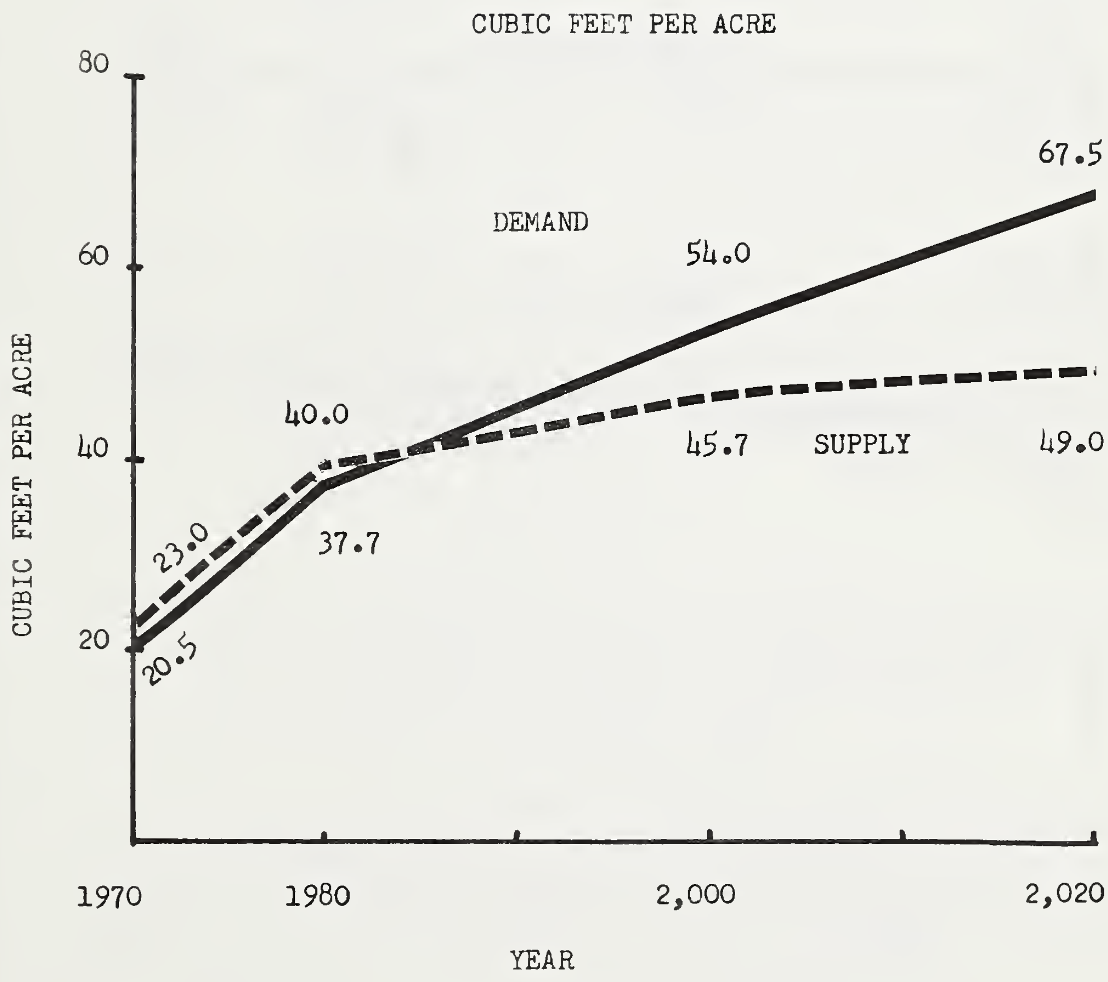
The fish and game resource produces an annual total value to participants of $56.3 million (table 3.12). This amount is based on the value placed on the worth of a day's hunting or fishing to the participants. Although this figure exceeds the actual expenditure for a day's use of the fish and game resource, it clearly shows the potential economic value of the present wildlife resource. Actual expenditures for hunting were $8.1 million for 1970 (table 3.13). This amount, with an income multiplier of 2.7, produced a net effect to the economy of the basin of $21.9 million annually.

Figure 3.2: Demand and supply of roundwood, Yazoo- Mississippi River Basin, 1970 and projected 1980, 2000, and 2020



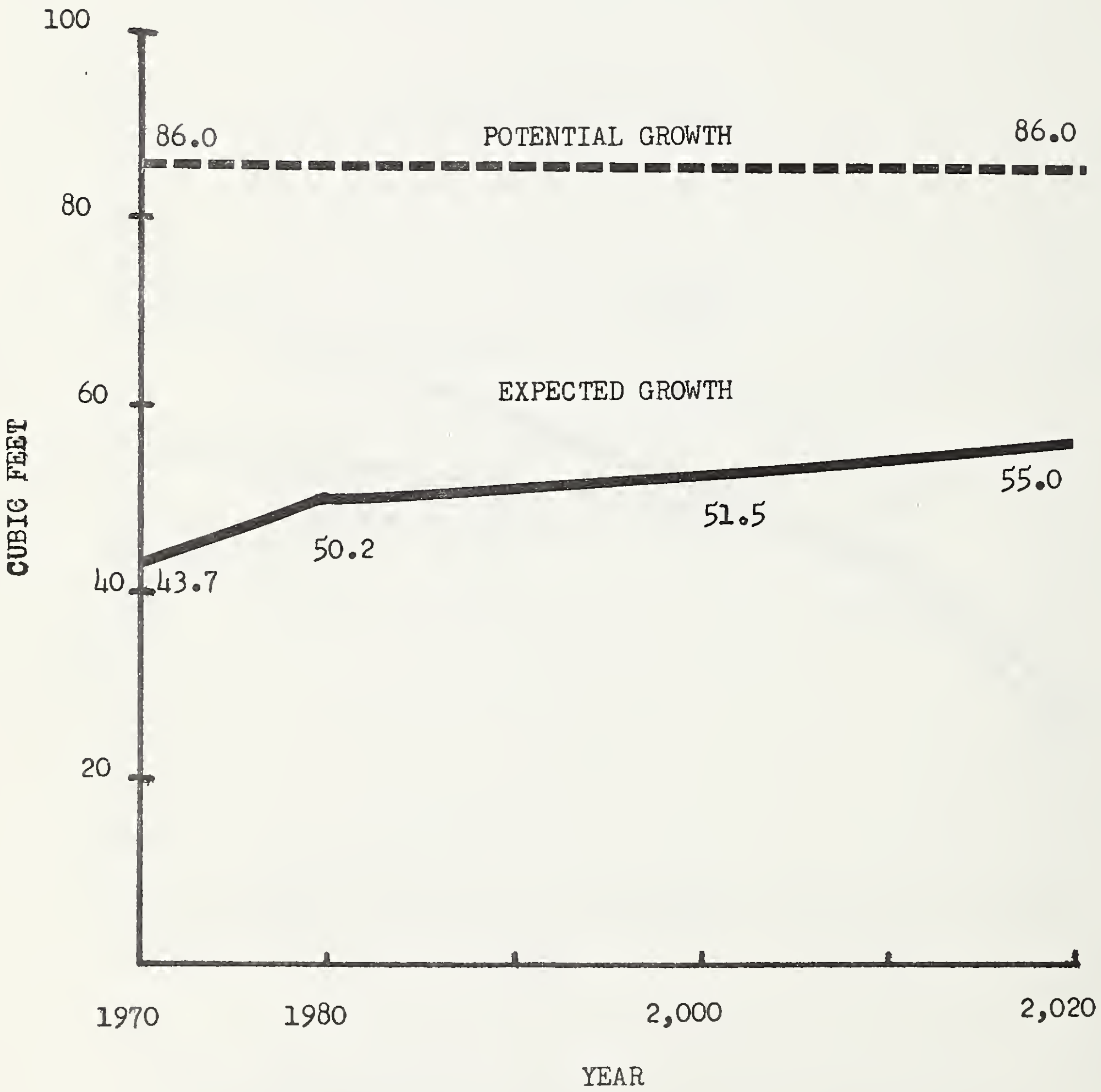
Source: OBERS projections adjusted to hydrologic basin boundaries

Figure 3.3: Demand and supply of roundwood, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020



Source: OBERS projections adjusted to hydrologic basin boundaries.

Figure 3.4: Timber growth per acre under current trends of management as compared to average potential growth, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020



Source: Based on 1969 Forest Survey information, U.S. Forest Service.

Table 3.12. Value received by participants for hunting and fishing, resident licensed hunters and fishermen only, Yazoo-Mississippi River Basin

Subarea	Resident licensed participants	Average daily value received by participants	Total value received by participants
	Man days	Dollars	Dollars
Delta			
Hunting	628,954	33.65	21,164,302
Fishing	458,100	19.15	8,772,605
Total	1,087,054		29,936,917
Uplands			
Hunting	480,139	33.65	16,156,677
Fishing	531,400	19.15	10,176,310
Total	1,011,539		26,332,987
Basin			
Hunting	1,109,093	33.65	37,320,979
Fishing	989,500	19.15	18,948,925
Total	2,098,593		56,269,904

Source: Adapted from Mississippi Executive Summary - Economic Survey of Wildlife Recreation, March 1974, Environmental Research Group, Georgia State University.

Transportation

A section of the Mississippi River constitutes the western boundary of the basin. It is presently used extensively and provides vast opportunity for greater use and development. A shallow-draft channel on the Yazoo River makes interior navigation possible, although the potential for interior navigation has not been reached.

Harbor and port facilities at Vicksburg, Greenville, and Yazoo City, Mississippi, provide complete public terminal and warehousing facilities. Numerous private facilities operate on the Mississippi and Yazoo Rivers and plans for additional port development are underway. Thus, the area is continually becoming better equipped to handle water-borne commerce.

Railway transportation is provided by mainline routes of the Illinois Central System which traverse the basin in a north-south direction. This service provides direct routes to New Orleans, points in the North-Central United States, and major terminals outside the basin.

Table 3.13. Average annual hunter participation, harvest, and game species economic data, Yazoo-Mississippi River Basin, 1971-1973

Species	Subarea	Total Hunters	Total Days afield	Total harvest	Average daily bag	Average days afield	Average season bag	Value per animal harvested	Value of all animals harvested
		Number	Number	Number	Number	Number	Number	Dollars	Dollars
Dove	Delta	14,186	77,008	423,940	5.51	5.43	29.88		398,504
	Uplands	12,110	57,764	351,012	6.08	4.78	29.06	.94	329,951
	Basin	26,296	134,672	774,952	5.75	5.12	29.44		728,455
Quail	Delta	3,182	17,620	40,762	2.31	5.54	12.79		66,850
	Uplands	9,319	82,300	280,095	3.40	8.83	30.02	1.64	459,356
	Basin	12,501	100,920	320,857	3.18	8.07	25.67		526,206
Rabbit	Delta	15,081	144,504	260,590	1.80	9.58	17.28		390,885
	Uplands	10,751	81,605	131,784	1.61	7.59	12.22	1.50	197,676
	Basin	25,832	226,109	392,374	1.74	8.75	15.19		588,561
Squirrel	Delta	18,268	139,277	327,984	2.35	7.62	17.95		429,659
	Uplands	18,197	140,375	307,448	2.19	7.71	16.88	1.31	402,757
	Basin	36,465	279,652	635,432	2.27	7.67	17.43		832,416
Turkey	Delta	2,709	8,309	1,326	0.16	3.07	0.49		84,890
	Uplands	1,189	4,410	267	0.06	3.71	0.22	64.02	17,093
	Basin	3,898	12,719	1,593	0.12	3.26	0.41		101,984
Deer (Archery)	Delta	3,483	27,304	1,028	0.04	7.84	0.30		300,998
	Uplands	1,578	8,638	244	0.03	5.47	0.16	292.80	71,443
	Basin	5,061	35,942	1,272	0.04	7.10	0.25		372,442
Deer (Gun)	Delta	18,800	128,360	10,079	0.08	6.83	0.54		2,951,131
	Uplands	12,565	83,071	2,819	0.03	6.61	0.20	292.80	825,403
	Basin	31,365	211,431	12,898	0.06	6.74	0.41		3,776,534
Deer (Primitive Weapon)	Delta	1,681	7,123	856	0.12	4.24	0.51		250,637
	Uplands	918	5,173	212	0.04	5.64	0.23	292.80	62,074
	Basin	2,599	12,296	1,068	0.08	4.73	0.41		312,710
Duck	Delta	9,840	76,369	148,888	11.87	8.07	15.13		762,306
	Uplands	3,030	16,803	26,166	1.56	5.55	8.64	5.12	133,970
	Basin	12,870	26,172	175,054	1.82	7.47	13.60		896,276
Total value of all game harvested	Delta								5,635,860
	Uplands								2,499,723
	Basin	XXX	XXX	XXX	XXX	XXX	XXX	XXX	8,135,584

Source: Adapted from Mississippi Mail Survey of Game Harvest, 1971-72 and 1972-73, Mississippi Game and Fish Commission.

A network of interstate, federal, and state highways within the basin offers adequate access to all sections and to other areas of the United States. Interstate Route 55 runs in a north-south direction and is located near the eastern boundary. United States Route 61 traverses the western boundary and United States Route 82 crosses the midsection from east to west. Other federal and state highways provide additional transportation facility coverage.

Scheduled airline service is provided to Greenville, Cleveland, Oxford, and Greenwood, Mississippi, by Southern Airlines. Modern airports and airlines offer adequate transport, air freight, and air charter service to all sections of the nation.

Thus the basin has an adequate diversified transportation system, although there are substantial opportunities for improvement. These improvements should occur as the need develops, thus contributing to the economic development of the basin.

Relationship of Economic Development and Land and Water Resource Development

By 2020, approximately 779 thousand people are expected to live in the basin, supported by $8.2 billion in personal income earned by approximately 312 thousand workers and entrepreneurs. This means that between 1970 and 2020, population will rise 39 percent, employment 54 percent, and personal income 630 percent.

However, these projections of population, employment, income, and food and fiber requirements presented herein are based on extensions of historical trends. The historical period was characterized by rapid economic development coupled with relatively abundant and cheap energy. A decreasing rate of growth in energy supplies causing higher relative prices for inputs could influence the future role of water resource development. In general, the market place will dictate the relative efficiency of various means of increasing food and fiber production. The basin currently uses large quantities of artificial fertilizers, pesticides, fuels, and other petroleum based products. It is too early to determine the effects of recent trends in energy prices and export markets on the efficiency of the yield increasing technology relative to improved drainage and irrigation which require heavy capital expenditures.

However, the delta subarea is inherently a highly productive agricultural area indicating that continued improvement in the agricultural plant will contribute to national economic development.

The projections of economic growth were guided by the assumption that sufficient quantities of water of an acceptable quality would be

made available by timely development in such a manner as to avoid being a constraint to economic growth. If this is not accomplished, inadequate water resources may inhibit the basin's economic growth and adversely affect projected rates of economic progress.

Failure of growing cities to develop additional sources of clean fresh water will restrict their ability to serve the growing human and industrial population, thus causing the economic development of such cities to lag behind the projected growth. Failure to correct pollution problems in some sections will deter the location of major water-using industries in these sections, causing employment growth to falter and adversely affecting income that would have been created and population that would have been supported by this additional employment.

Demands in coming decades on the water supplies will arise basically from the increase in population and the expansion of industry. Water requirements, however, will be greater than indicated by projected levels of population and industrial employment because of trends now evident in the basin. Increased urbanization will raise water demands, as per capita consumption is higher in cities. More leisure time will amplify demands for water related recreational uses.

The basin is endowed with abundant supplies of usable industrial water which should sustain growth in industries requiring relatively large quantities of water in manufacturing processes. Unlike many water-short regions in the United States where extensive use of water in industry is required together with costly pollution treatment facilities, the basin possesses the natural resource assets fundamental to employment gains in all groups of major water-using industries.

Municipal water problems are ones of variations in the quantity and quality of water. Because of problems of yearly, seasonal, and irregular variations of rainfall, the quantity of water in a given place and time is never constant. Cities must construct storage facilities to offset such variations as well as plan for increased demands for water in the future. Rising per capita consumption, the trend toward industries favoring municipal water supply, and the expansion of residential areas farther away from the cities' core are examples of the needs for adequate planning. Anticipation of these demands must be made, distribution systems must be expanded and improved, and adequate supplies for projected peak demands provided if the cities and other users are to experience optimum economic growth. What is required is not more water as such but more foresight as to future needs, the willingness to finance preparation of water development plans, and construction of additional water facilities needed.

CHAPTER IV

WATER AND RELATED LAND RESOURCE PROBLEMS AND NEEDS

General

Identifying water and related land resource problems is the first important step in resource conservation, utilization, and development. This step, in conjunction with estimates of what the future portends, is necessary before the people can plan for the satisfaction of human needs associated with land and water resource development.

The human needs to be satisfied by land and water resources conservation and development furnish both the reason for planning and the scale of the ultimate plan. Some resource conservation and development has already been accomplished in the basin. Some unsatisfied need exists, and some will develop as the population increases.

Many of the problems and needs of the basin relate to the quality of the environment. Erosion damages the land resource base and the scenic values of the landscape. The resulting sediment deteriorates the quality of water, fills streams and lakes, and damages land. Flooding provides the means of transportation for sediment, agricultural insecticides, and animal wastes among other pollutants. These pollutants decrease water quality, damage fish resources, and reduce aesthetic values in addition to increasing turbidity of streams and lakes.

Determination of the magnitude of present and future problems and needs is essential. This chapter briefly discusses the present (1970) status of and future problems and needs for water and related land resources in the Yazoo-Mississippi River Basin.

The basin was divided into different subareas for selected problems and needs to make data appraisal more meaningful. The division allows for better correlation of data within the basin and provides a small enough area to illuminate problem areas. The basin, when modified to conform to county boundaries, occupies 26 complete counties. The hydrologic area excluded is comprised of small portions of Tippah, Chickasaw, Montgomery, and Webster counties. Special subareas are composed as follows:

Subarea	Counties
1	DeSoto, Marshall, Tunica, Tate, Quitman
2	Benton, Union, Pontotoc, Lafayette, Panola, Tallahatchie
3	Calhoun, Yalobusha, Grenada
4	Coahoma, Bolivar, Sunflower, Humphreys
5	Leflore, Carroll, Holmes, Yazoo, Issaquena, Warren, Sharkey
6	Washington

Water Withdrawals

In 1970 approximately 874 million gallons per day (mgd) were withdrawn from the basin's surface and ground water supplies for various uses. About 370 million gallons per day were consumptively used. Total basin 1970 use and projected needs for 1980, 2000, and 2020 are summarized in table 4.16 which follows individual use category discussions.

Municipal Water Supply

Present Status - The population of the basin in 1970 was approximately 638,000, about 10 percent of the total population for the Lower Mississippi Region and about 29 percent of the State of Mississippi. Fifty-seven percent of the population of the basin was serviced by some form of central water system while 43 percent was not. Municipal water systems serviced 237 communities, varying in size from 33 people in Cobb, Mississippi, to almost 40,000 people in Greenville, Mississippi. Of the 237 communities, 42 had populations over 2,500 and four had populations of over 20,000 - Greenville, Vicksburg, Greenwood, and Clarksdale.

In 1970 the average daily municipal water withdrawal within the basin was 53.8 million gallons (table 4.1). During July, the peak municipal water use month in 1970, the average daily use was 60.2 million gallons. All of the water was supplied from ground water sources. The withdrawal of 53.8 mgd resulted in 147 gallons per capita day (GPCD) use in areas serviced by central water systems, as compared to the national average of 166 GPCD.

Withdrawal requirements far exceed actual consumptive use. Of the 53.8 mgd withdrawn in 1970, only 20.0 mgd were consumed.

The ground water quality within the basin varies according to the type aquifer, the aquifer composition, the location of the well in the aquifer, and the substrata through which the recharge drains. Accordingly, the treatment requirements prior to use and the method of treatment vary widely throughout the basin. Treatment varies from a simple chlorination process in some communities to elaborate

Table 4.1. Municipal water use, Yazoo-Mississippi River Basin, 1970

Subarea and county	Population	Municipal water use1/			
		Systems	Ground	Surface	Total
	Number	Number	mgd	mgd	mgd
Area 1					
Tunica	3,115	2	.4	0	.4
Tate	7,932	6	.9	0	.9
Quitman	5,199	8	.5	0	.5
Marshal	7,132	4	1.0	0	1.0
DeSoto	22,322	20	2.1	0	2.1
Area 2					
Union	9,414	7	1.1	0	1.1
Tallahatchie	8,828	12	.8	0	.8
Pontotoc	6,326	6	1.1	0	1.1
Panola	14,434	17	1.9	0	1.9
Lafayette	21,747	15	1.6	0	1.6
Benton	1,007	3	.1	0	.1
Area 3					
Calhoun	10,356	18	.8	0	.8
Yalobusha	6,328	6	1.6	0	1.6
Grenada	15,180	9	1.5	0	1.5
Area 4					
Coahoma	26,140	10	3.3	0	3.3
Bolivar	26,650	13	3.6	0	3.6
Sunflower	21,149	11	2.4	0	2.4
Humphreys	6,213	6	.6	0	.6
Area 5					
Leflore	26,770	8	6.9	0	6.9
Carroll	2,780	5	.2	0	.2
Holmes	15,165	17	4.3	0	4.3
Yazoo	14,011	9	1.9	0	1.9
Issaquena	200	1	.02	0	.02
Sharkey	3,131	3	.3	0	.3
Warren	31,503	9	6.9	0	6.9
Area 6					
Washington	53,088	12	8.0	0	8.0
Total	366,120	237	53.8	0	53.8

Source: Inventory of Facilities, Appendix D, Lower Mississippi Region Comprehensive Study.

1/ All figures are daily averages.

systems of chlorination, aeration, filtration, fluoridation, and pH correction in others.

Future Needs - The total population of the basin is expected to increase through 2020 and the percentage of the population serviced by municipal water distribution will increase. It is expected that the conversion from self-supplied to centralized rural or municipal water service will result in 80 percent of the rural population and 100 percent of the urban population being served by central water systems by 2020.

Increased use of indoor plumbing, modern water-using applicances, and extra care in maintenance of possessions, i.e., watering lawns, washing cars, etc., cause an increase in GPCD consumed and therefore is considered in projecting water needs. Future municipal water needs are presented in table 4.2. Needs are projected to increase from 53.8 mgd in 1970 to 65.7 in 1980, to 89.8 in 2000, and to 123.7 in 2020.

Industrial Water Supply

Present Status - Industrial activity within the basin during 1970 required a daily average water withdrawal of 86.6 mgd. Ground water supplied 57 percent and surface sources 43 percent (table 4.3).

In subarea one, the industries utilizing the bulk of the 9.5 mgd produce finished food products, petroleum derivative products, chemicals, and fertilizers. Subareas two, three, and four have several types of industries, but no individual large water users.

Table 4.2. Future municipal water needs, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Subarea	1980		2000		2020	
	Withdrawal	Consumption	Withdrawal	Consumption	Withdrawal	Consumption
	mgd	mgd	mgd	mgd	mgd	mgd
1	6.0	2.2	8.2	3.0	11.5	4.3
2	7.9	2.9	10.8	4.0	15.1	5.6
3	4.8	1.8	6.5	2.4	9.0	3.4
4	12.1	4.5	16.5	6.2	23.1	8.6
5	25.1	9.2	34.4	12.8	48.0	17.9
6	9.8	3.6	13.4	5.0	17.0	6.3
Total	65.7	24.2	89.8	33.4	123.7	46.1

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Table 4.3. Industrial water use, Yazoo-Mississippi River Basin, 1970

Subarea	Withdrawal: Ground water	Withdrawal: Surface water	Total consumption
	mgd	mgd	mgd
1	9.5	0	3.5
2	1.6	0	0.9
3	2.3	0	0.7
4	6.0	0	0.5
5	17.7	37.5	1.1
6	12.0	0	0.4
Total	49.1	37.5	7.1

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Subarea five uses 55.2 mgd in its food processing industries; chemical, paper, and fertilizer producing industries; and in the production of lumber and wood products. In subarea six, 12.0 mgd is withdrawn for use in the food processing industries, metal products fabrication, and fiber board and chemical production. Because the industries in the basin produce a wide variety of goods, each industry has its own water quality requirements and subsequent treatment. The degree of treatment ranges from no treatment in industries using water as cooling agent for bearings or condensers to a full five-step system of treatment in some food producing industries.

Future Needs - Projections indicate that the total population of the basin will increase through 2020 and industries are expected to continue their present trend of increasing productivity. Industrial classifications expected to show the most pronounced growth are the textile, chemical, and petroleum refining industries, all of which are major water-using industries.

The future water requirement of an industry is dependent on employment, index of employee production, and the degree to which water is used. Examination of these factors along with industrial location trends helps explain the variation of water use among the subareas. The future industrial water needs are presented in table 4.4

Rural Domestic Water Supply

Present Status - Forty-three percent of the population in the basin is served by individually-owned water systems. In 1970, farmers and others who furnished their own water withdrew about 21.7 mgd from wells and springs (table 4.5). All water is supplied from ground water sources and all water withdrawn is considered as consumed.

Table 4.4. Future industrial water needs, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Subarea	1980		2000		2020	
	Withdrawal	Consumption	Withdrawal	Consumption	Withdrawal	Consumption
	mgd	mgd	mgd	mgd	mgd	mgd
1	11.9	4.5	22.4	8.5	42.2	16.2
2	2.3	1.3	5.4	3.4	12.1	8.0
3	3.5	1.0	8.3	2.5	18.6	5.7
4	8.7	0.7	20.0	1.6	45.1	3.6
5	90.3	1.8	216.0	4.2	495.6	9.6
6	18.8	0.6	48.3	1.4	115.7	3.5
Total	135.5	9.9	320.4	21.6	729.3	46.6

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Table 4.5. Rural domestic water use, Yazoo-Mississippi River Basin, 1970

Subarea	Withdrawal	Consumption
	mgd	mgd
1	4.8	4.8
2	4.2	4.2
3	1.2	1.2
4	4.9	4.9
5	5.2	5.2
6	1.4	1.4
Total	21.7	21.7

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Future Needs - It is expected that 80 percent of the rural population and 100 percent of the urban population will be served by central water systems by 2020. As a result, the amount of water withdrawn under the rural domestic category will decline. Future rural domestic water needs are presented in table 4.6. All water withdrawn is considered as consumed.

Table 4.6. Future rural domestic water needs, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Subarea	1980 Withdrawal	2000 Withdrawal	2020 Withdrawal
	mgd	mgd	mgd
1	4.2	3.3	2.5
2	3.7	2.8	2.1
3	1.0	0.8	0.6
4	4.3	3.3	2.5
5	4.5	3.5	2.7
6	1.2	1.0	0.7
Total	18.9	14.7	11.1

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Thermoelectric Power Water Supply

Present Status - Due to the large volume of water required to cool condensers in thermoelectric units, all plants in the basin either use surface water for cooling purposes or use ground water recirculated through cooling towers. There are seven thermoelectric plants located in the basin - one each in Vicksburg, Yazoo City, and Cleveland, and two each in Greenwood and Clarksdale. A new plant was recently constructed in Greenville and went on line in 1973. The seven existing plants in 1970 produced enough power to meet electric power requirements for the basin and supply surplus power to the interconnected systems of the Southwestern Power Pool members. In 1970, water withdrawals were 305 mgd (table 4.7). Surface water accounted for 90 percent and ground water 10 percent.

Five of the seven plants utilize ground water and two surface water. The plants which use ground water are smaller and generally produce power for their immediate area, i.e., the city or county in which they are located. In some instances, the water used by these plants is derived from the municipal water systems. The two plants using surface water are large compared to the plants using ground water and supply power over a greater area, including portions of other states. The water used by these plants is withdrawn from the Mississippi and Sunflower Rivers.

Future Needs - Based on projected population and average daily per capita kilowatt use, it is expected that thermoelectric plants will produce a surplus of power through 1980. Surpluses are supplied to other areas through the interconnected systems of the Southwestern Power Pool members. Projected thermoelectric water requirements are presented in table 4.8.

Table 4.7. Thermoelectric power water use, Yazoo-Mississippi River Basin, 1970

Item	Ground	Surface	Total
	mgd	mgd	mgd
Withdrawal	31.1	273.9	305.0
Consumption	0.3	2.4	2.7
Return flow	30.8	271.5	302.3

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

Table 4.8. Future thermoelectric power water needs, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Item	1980	2000	2020
	mgd	mgd	mgd
Withdrawal	995.2	995.2	1,107.3
Consumption	10.6	10.6	14.7
Return flow	984.6	984.6	1,092.6

Source: Municipal and Industrial Water Supply, Appendix K, Lower Mississippi Region Comprehensive Study.

The quality of the water now used in cooling thermoelectric condensers is generally not a critical factor. The large plants that use once-through cooling water directed from streams generally only screen out trash that may impede their pumps. The smaller plants which utilize cooling towers to recirculate ground water apply no treatment before use.

Irrigation Water Supply

Present Status - The amounts of rainfall and its distribution throughout the year, especially the growing season, has a very definite effect on the need for and use of irrigation. Irrigation is not a definite requirement for crop production in the basin. There are exceptions, of course--rice and some truck crops. Most of the crops can be grown successfully without irrigation. Irrigation as used in the basin, with the exception of rice and some truck crops, is a management tool and an insurance against the drought periods that do occur. Rice under present cultural practices has to have irrigation for successful production.

Presently, the total irrigated acreage is estimated at about 157,200 acres with about 51,700 acres of rice, 68,000 of cotton, and 29,000 acres of soybeans being the major crops irrigated (table 4.9). Most of the irrigation is in the Southern Mississippi Valley Alluvium Land Resource Area. The heavier soils of this land resource area are well suited for cotton, soybeans, and other crops grown. The soils of the Southern Mississippi Valley Silty Upland and the Southern Coastal Plains are suitable for all locally-grown crops where topography will allow.

Most of the present irrigated acres are supplied by private irrigation systems. Approximately 331,500 acre feet of water was used in 1970. An estimated 40 percent is supplied from ground water sources and 60 percent from surface water sources.

Future Needs - In order for the basin to produce its share of the nation's future food and fiber output, water must be available for growing those crops (rice and vegetables) which will not consistently produce satisfactory yields without irrigation. Acreages requiring irrigation are expected to show a steady increase through 2020 (table 4.10). Acreages supplementary irrigated are also expected to show a steady increase throughout the study period.

Table 4.9. Present irrigated acreage and associated water requirements, Yazoo-Mississippi River Basin, 1970

Crop	Irrigation water requirement	Area irrigated	Water requirement
	Ac. ft./Ac.	Acres	Ac. ft.
Soybeans	1.51	28,980	43,760
Cotton	1.43	67,986	97,220
Corn	1.82	1,737	3,161
Rice	3.32	51,655	171,495
Hay	2.55	0	0
Pasture	2.55	6,020	15,351
Vegetables	0.64	845	541
Miscellaneous	1.59 1/	0	0
Total	XXX	157,223	331,528

Source: Irrigation, Appendix H, Lower Mississippi Region Comprehensive Study.

1/ Average of soybeans, cotton, corn, hay, and vegetables.

Table 4.10. Future irrigated acreage and associated water requirements, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Crop	1980		2000		2020	
	Area irrigated	Water requirement	Area irrigated	Water requirement	Area irrigated	Water requirement
	Acres	Ac. ft.	Acres	Ac. ft.	Acres	Ac. ft.
Soybeans	38,417	58,010	43,428	65,576	45,934	69,360
Cotton	60,622	86,689	59,873	85,618	58,731	84,000
Corn	658	1,198	825	1,502	900	1,638
Rice	55,900	185,588	61,900	205,508	70,000	232,400
Hay	1,805	4,603	1,615	4,118	2,150	5,483
Pasture	6,020	15,351	6,020	15,351	6,020	15,351
Vegetables	3,373	2,159	2,993	1,916	2,613	1,672
Total	166,795	353,598	176,654	379,589	186,348	409,904

Source: Adapted from Irrigation, Appendix H, Lower Mississippi Region Comprehensive Study.

Livestock Water Supply

Present and Future Needs - A source of rural demand for water is the livestock industry. Many factors influence the consumption of water by livestock. Water intake by animals generally parallels the dry matter in feeds when animals are on dry feeds. Also, water intake is affected by the water content of the feed itself. The level of production will also affect water consumption. Therefore, there are no clear-cut estimates because of rations and level of production. Water requirements were based on applicable daily water requirement rates per animal and livestock numbers.

In 1970, practically all of the estimated 9,600 acre feet (9 mgd) used by livestock and poultry was supplied by private sources. An estimated 40 percent was supplied from ground water sources and 60 percent from surface water sources.

Present and projected livestock and poultry numbers and associated water requirements are presented in table 4.11. Water for livestock is not a problem insofar as supply is concerned. Adequate water is available from wells, springs, and streams in all parts of the basin. The potential water supply is deemed adequate to supply projected needs

Table 4.11. Annual water requirements, Yazoo-Mississippi River Basin, 1970, and projected 1980, 2000, and 2020

Type of livestock	Water use Ac. Ft./Yr. Per Unit 1/	1970 Number of Units	1970 Water Use Ac.Ft.	1980 Number of Units	1980 Water Use Ac.Ft.	2000 Number of Units	2000 Water Use Ac.Ft.	2020 Number of Units	2020 Water Use Ac. Ft.
Cattle & calves	.01120319	695,300	7,790	885,534	9,921	1,192,022	13,354	1,600,859	17,935
Milk cows	.02240638	46,100	1,033	42,338	949	52,254	1,171	63,816	1,430
Hogs & pigs	.00336096	181,600	610	270,242	908	270,693	910	351,396	1,181
Sheep & lambs	.00224064	14,200	32	10,899	24	12,814	29	15,769	35
Chickens	.00004481	2,091,900	94	2,298,161	103	2,941,839	132	3,726,511	167
Broilers	.00000688	5,929,500	41	8,269,874	57	11,547,108	79	15,502,678	107
Turkeys	.00006722	5,900	1	7,877	1	11,070	1	14,948	1
Total	XXX	XXX	9,601	XXX	11,963	XXX	15,676	XXX	20,856

Source: Irrigation, Appendix H, Lower Mississippi Region Comprehensive Study.

1/ Water use per day: Cattle and calves, 10 gallons per day; hogs and pigs, 3 gallons per day; sheep and lambs, 2 gallons per day; chickens and broilers, .04 gallons per day; turkeys, .06 gallons per day; and milk cows, 20 gallons per day.

Cattle and calves: 10 gallons per day x 365 ÷ 325,800 = .01120319 ac. ft. per year per animal.
Hogs and pigs : 3 gallons per day x 365 ÷ 325,800 = .00336096 ac. ft. per year per animal.
Sheep and lambs : 2 gallons per day x 365 ÷ 325,800 = .00224064 ac. ft. per year per animal.
Chickens : .04 gallons per day x 365 ÷ 325,800 = .00004481 ac. ft. per year per bird.
Broilers : .04 gallons per day x 365 ÷ 325,800 = .00000688 ac. ft. per bird grown.
Turkeys : .06 gallons per day x 365 ÷ 325,800 = .00006722 ac. ft. per year per bird.
Milk cows : 20 gallons per day x 365 ÷ 325,800 = .02240638 ac. ft. per year per animal.

Mineral Water Supply

Present Status - Oil and gas output in the southern part and widespread production of construction minerals define the mineral industry activity in the basin. Sand and gravel are produced in more than half the counties in the basin in any given year to meet local needs. Clay is produced in several counties, mostly for local consumption, and stone is produced in Warren County. Cement is manufactured in Warren County from locally-produced minerals for regionwide markets.

The estimated 1970 water withdrawn for mineral use was 1.1 mgd. Seventy-three percent was from surface water and 27 percent was from ground water sources. Water withdrawal needs are presented in table 4.12.

Future Needs - Needs for mineral water withdrawal are expected to increase from a current use of 1.1 mgd to about 1.6 mgd by the year 2020, a 45 percent increase. Consumption is estimated to be about 45 percent of withdrawals. Table 4.12 provides withdrawal and consumptive use data for future mineral water needs in the basin.

Fish and Wildlife Water Supply

Present Status - Water withdrawn in 1970 for fish and wildlife purposes amounted to 31.0 mgd, with 50 percent being from ground water and 50 percent from surface water sources. Consumption amounted to 23 mgd. Withdrawals were used to maintain water levels in management areas for mast producing green tree reservoirs and duck resting areas, and to replenish lakes for sport fishing. Water withdrawals are presented in table 4.13.

Table 4.12. Water withdrawal needs for minerals, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year	Withdrawal	Consumption
	mgd	mgd
1970	1.1	0.5
1980	1.1	0.5
2000	1.3	0.6
2020	1.6	0.7

Source: Related Mineral Resources, Appendix G, Lower Mississippi Region Comprehensive Study.

Table 4.13. Fish and wildlife water withdrawal needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year	Withdrawal	Consumption
	mgd	mgd
1970	31	23
1980	53	40
2000	83	59
2020	117	82

Source: Fish and Wildlife, Appendix Q, Lower Mississippi Region Comprehensive Study.

Future Needs - Future water withdrawal needs for fish and wildlife are related to an increasing population of sportsmen dependent in part upon existing and future management areas. Future needs are projected to increase from 31 mgd in 1970 to 117 mgd in 2020, an increase of 277 percent (table 4.13). Consumption based on present experience is estimated to be about 70 to 75 percent of withdrawals.

Commercial Fisheries Water Supply

Present Status - Fishes harvested from the waters of the basin are primarily wild fishes and catfish. Fishes in the catfish category included only those raised by the agricultural industry. Wild fishes consist of those caught for commercial purposes in freshwater streams and lakes.

In 1970, approximately 2.3 million pounds of wild fishes were harvested and 14.7 million pounds of catfish (table 4.14). Water withdrawals amounted to about 71 mgd and consumption 67 mgd. Eighty percent of the water withdrawn was from ground water sources and 20 percent from surface water sources.

Future Needs - Future harvests of wild fishes from the basin were not projected as no fresh water withdrawals are required for this fishery. It will be necessary to maintain the quality and regimen of the basin's rivers and streams to allow the continued harvesting of edible fishes.

There is foreseen a continued demand for all the catfish the basin's fish farming industry can produce. Future commercial fish production and water supply withdrawal needs are presented in table 4.15

Table 4.14. Commercial fish production and water use, Yazoo-Mississippi River Basin, 1970

Item	Unit	Quantity
Production		
Wild fisheries	1,000 lbs.	2,301
Catfish	1,000 lbs.	14,690
Water use		
Withdrawals	M.g.d.	(70.6)
Ground	M.g.d.	56.5
Surface	M.g.d.	14.1
Consumption	M.g.d.	67.1

Source: Soil Conservation Service, United States Department of Agriculture and Fish and Wildlife, Appendix Q, Lower Mississippi Region Comprehensive Study.

Table 4.15. Future commercial fish production and water supply withdrawal needs, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Item	Unit	1980	2000	2020
Production				
Wild fishes	1,000 lbs	2,301 1/	2,301 1/	2,301 1/
Catfish	1,000 lbs	54,600	75,000	94,500
Water use				
Withdrawal	M.g.d.	123.6	229.8	336.0
Consumption	M.g.d.	111.2	206.8	302.4

Source: Soil Conservation Service, United States Department of Agriculture, and Mississippi Game and Fish Commission.

1/ Wild fisheries production constant at 2.3 million pounds per year.

Catfish production is projected to increase from 14.7 million pounds in 1970 to 94.5 million pounds in 2020. Water withdrawals will increase from 70.6 mgd to 336.0 mgd during the same time frame.

Summary of Water Supply Needs

Table 4.16 presents a basin summary of 1970 withdrawals, projected withdrawals, and consumption by water use category. Major use categories are thermal, industrial, irrigation, and commercial fishing. These four uses accounted for 87 percent of all water withdrawn from the basin's surface and ground water supply in 1970. By 2020 they are expected to account for 90 percent of all withdrawals. Rural domestic water use, reflecting decreasing rural population and greater dependence on centralized water distribution systems, will be the only use category to exhibit a decline in future decades.

Land

Land is called upon to satisfy a multiplicity of competing needs. This competition will intensify with population growth and increasing demands for food and fiber, minerals, industrial sites, recreational sites, and urban areas.

Land areas are herein classified cropland, permanent pasture, pastured cropland, forest land (including pastured forests), urban and built-up lands, mineral lands, recreation lands, fish and wildlife lands, and other lands which include not only tracts of agricultural lands unavoidably idle as a part of the cropland mix, but also miscellaneous lands, rural roads, nonforested public lands, and the like. Croplands, pasture lands, and forest lands are used not only for food and fiber production, but also for wildlife purposes. Both open lands and forest lands are used for residential, commercial, and industrial purposes. They are also used for recreation and environmental quality purposes and include transportation facilities. Other lands are used for a variety of purposes, including fish and wildlife habitat (wetlands), commercial fish farming, and minerals production.

Cropland

Present Status - In 1970 cropland in the basin totaled 3.64 million acres. Approximately 2.97 million acres were harvested. The harvest included 1.2 million bales of cotton, 38.5 million bushels of soybeans, 2.4 million bushels of oats, 1.9 million bushels of corn, 5.0 million bushels of rice, 3.8 million bushels of wheat, and lesser quantities of other crops such as silage, vegetables, hay, potatoes, peanuts, and grain sorghum (see table 3.6).

Table 4.16. Summary of present and projected water withdrawals, by category, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Use	1970		1980		2000		2020	
	Withdrawal	Consumption	Withdrawal	Consumption	Withdrawal	Consumption	Withdrawal	Consumption
	mgd							
Municipal	53.8	20.0	65.7	24.2	89.8	33.4	123.7	46.1
Industrial	86.6	7.1	135.5	9.9	320.4	21.6	729.3	46.6
Rural domestic	21.7	21.7	18.9	18.9	14.7	14.7	11.1	11.1
Thermal	305.0	2.7	995.2	10.6	995.2	10.6	1,107.3	14.7
Irrigation	295.8	219.2	315.6	233.8	338.8	251.0	365.9	271.0
Livestock	8.6	8.6	10.7	10.7	14.0	14.0	18.6	18.6
Minerals	1.1	0.5	1.1	0.5	1.3	0.6	1.6	0.7
Fish & wildlife	31.0	23.0	53.0	40.0	83.0	59.0	117.0	82.0
Commercial fishing	70.6	67.1	123.6	111.2	229.8	206.8	336.9	302.4
Total	874.2	369.9	1,719.3	459.8	2,087.0	611.7	2,811.4	793.2

Source: Summarized from data previously presented in tables 4.1 through 4.15.

Future Needs - Basin food and fiber production requirements based on 1972 OBERS data are projected to increase 80 percent between 1970 and 2020. Satisfaction of this production goal will require 397,700 more harvested cropland acres with development, and 1,154,500 acres without development. Future cropland needs with development are summarized in table 4.17.

Expressed needs for cropland represent the amount of land that must be used for crop production if the basin is to contribute its required share of the nation's future food and fiber. The methodology for calculating cropland needs embodies the assumption that the most suitable lands for continuous cropping will gravitate to that use regardless of present practice. Thus, the expressed future cropland acreages are not land use projections, but rather lands required to produce food and fiber consistent with a high level of management.

Pasture

Present Status - The basin ranks first in the Lower Mississippi Region in terms of cattle and calves, third in livestock marketing receipts, and fourth in pasture acreage. Approximately 1,856 thousand acres of the basin's land were pastured in 1970. About 326 thousand acres were pastured cropland (not included in previously discussed cropland use or needs), 943 thousand acres were permanent pasture, and 587 thousand acres were pastured forests (table 4.18). This pasturage supported 741,400 head of livestock - cattle, calves, and milk cows.

Table 4.17. Cropland needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020--with development

Year	Cropland		
	Harvested	Idle	Total
	Acres	Acres	Acres
1970	2,970,000	344,000	3,314,000
1980	3,215,000	216,000	3,431,000
2000	3,288,500	150,000	3,438,500
2020	3,367,700	100,000	3,467,700

Source: Translated from 1972 OBERS agricultural production data and field data on crop yields. See table 3.8 for without development.

Table 4.18. Pasture land needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Pasture land	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Pastured cropland	326,000	320,000	200,000	175,000
Permanent pasture	943,000	1,377,700	1,449,200	1,450,500
Pastured forests	587,000	700,000	750,000	800,000
Total	1,856,000	2,397,700	2,399,200	2,425,500

Source: River Basin Survey Staff, Jackson, Mississippi.

Future Needs - Increased production of meat products (primarily beef and veal) will be required to feed the future population of the basin and nation. Needs for beef and veal will increase sharply, almost doubling between 1970 and 1980, and further increasing to about 3.2 times today's production levels in 2020. The projected pasture land needs as cited in table 4.18 are regarded as conservative. The pressure exerted by the livestock sector on the land base can only be satisfied if management practices such as seeding, fertilization, clipping, and proper cattle/acre ratio are adopted and employed.

Other Land

Present Status - Approximately 291 thousand acres of the basin's lands were classed as other in 1970 (table 4.19). Such lands include farmsteads, rural farm roads, feed lots, levees, drainage ditches and ditch banks, fence and hedge rows, rural residences, investment tracts, and mineral lands.

Future Needs - Other lands are a unique mix of miscellaneous agricultural and nonagricultural rural lands. Basin needs for other lands are expected to decrease from 291 thousand acres in 1970 to 163 thousand acres in 2020 (table 4.19). The reduction will result due to increased farm efficiencies and the conversion of presently idle agricultural lands to more productive uses.

Urban and Built-up Lands

Present Status - Urban and built-up areas comprise 258 thousand acres, or 3.1 percent of total land in the basin (table 4.20). The area includes 28.9 thousand acres of urban land occupied by population centers with 5,000 and more inhabitants and 229.1 thousand

Table 4.19. Other land needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year	Area
	Acres
1970	291,000
1980	253,000
2000	230,000
2020	163,000

Source: River Basin Survey Staff, Jackson, Mississippi.

Table 4.20. Urban and built-up land use, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Land use	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Built-up	229,100	302,800	321,900	377,600
Urban	28,900	32,200	39,100	48,400
Residential	12,600	14,100	17,300	21,600
Commercial	1,800	2,000	2,500	3,100
Streets	7,100	7,700	8,600	9,800
Industrial	2,300	2,700	3,800	5,300
Public	5,100	5,700	6,900	8,600
Total built-up and urban	258,000	335,000	361,000	426,000

Source: Adapted from Land Resources, Appendix F, Lower Mississippi Region Comprehensive Study.

acres of land in built-up areas. The predominance of the latter is due primarily to the rural nature of the basin. Although the basin contains two cities with populations of more than 25,000 (Greenville and Vicksburg), there are relatively few other urban areas of any size in the basin. For the most part, the basin is characterized by small towns of less than 5,000 in population and built-up areas.

Land use requirements for urban acreage occupied by cities with populations of 5,000 and larger were divided into five categories: residential, commercial, streets, industrial, and public. Residential land usage is the principal category with 12.5 thousand acres, or 43 percent of the total. Other categories in order of size are streets, with 7.1 thousand acres; public, with 5.1 thousand acres; industrial, with 2.3 thousand acres; and commercial, with 1.8 thousand acres.

Future Needs - Projected land use needs for urban and built-up areas in the basin are presented in table 4.20. Needs for total urban and built-up areas will increase by 168.1 thousand acres between 1970 and 2020. This is an increase of 65 percent.

Total land needs for urban areas of 5,000 or more inhabitants is expected to increase to 32.2 thousand acres by 1980, to 39.1 thousand acres by 2000, and to 48.4 thousand acres by 2020. The composition of this urban land is not expected to change drastically during the 50-year period. Residential land needs will increase by the greatest amount of any usage category. In 2020 residential land needs will be 21.6 thousand acres compared to 12.5 thousand acres in 1970. Industrial land usage will have the greatest percentage increase, going from 2.3 thousand acres in 1970 to 5.3 thousand acres in 2020, an increase of 130 percent.

Commercial Fish Farming

Present Status - About 14.7 million pounds of catfish were produced in the basin in 1970. These shallow man-made ponds occupied 11.3 thousand acres of land or 25 percent of the total commercial fish production acreage in the Lower Mississippi Region (table 4.21). Because the water surface area of these ponds is incidental to fish production, and does not lend itself to multiple use, the areal requirements for commercial fish farming are expressed in terms of land area rather than water surface.

Future Needs - Commercial catfish production is projected to increase from 14.7 million pounds in 1970 to 94.5 million pounds in 2020. Land needs necessary to sustain this level of increasing output of catfish will require 26 thousand acres in 1980, 30 thousand acres in 2000, and 35 thousand acres in 2020 (table 4.21).

Table 4.21. Land needs for commercial fish farming, Yazoo-Mississippi River Basin, 1970, 1973, and projected 1980, 2000, and 2020

Year	Land Needs
	Acres
1970	11,300
1973	23,360
1980	26,000
2000	30,000
2020	35,000

Source: Soil Conservation Service, United States Department of Agriculture.

Mineral Land

Present Status - Land used by the mineral industry is a small fraction of total acreage in the basin. Mineral industry land use amounted to an estimated 3.3 thousand acres in 1970 (table 4.22). Nonmetallic use accounted for 3.2 thousand acres and fuels for only 100 acres.

Future Needs - Projections of land needs for mineral output will change very little over the next 50 years. Practically all future needs are associated with increased output of nonmetallic minerals. Land needs for this use will increase from 3.2 thousand acres in 1970 to 5.1 thousand acres in 2020 (table 4.22).

Forestry

Present Status - Several inter-related factors have resulted in a forest resource that will not supply the projected demands for forest products in the basin after the year 1980. These factors include conversion of land, poor stocking, limited investments, underdeveloped growth rates, insects and diseases, fire, and poor utilization of present growing stock. Currently, under the present trends of management, forest lands are producing 44 cubic feet per acre per year. By 2020, the production is projected to be 55 cubic feet or about 64 percent of the maximum potential.

Poor stocking with low growth rates and limited investments all result in forest production well below the potential growth for one-fourth of all the forestland. Almost one-third of the forestland is well stocked while 43 percent has only acceptable stocking. Areas poorly stocked with desirable growing stock is the major reason for the present low average production of forest products. If these present trends in management continue, demands for forest products in the future cannot be met.

Table 4.22. Mineral land use, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Commodity	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Fuels	100	100	125	150
Nonmetallic minerals	3,200	3,300	3,850	5,100
Total	3,300	3,400	3,975	5,250

Source: Related Mineral Resources, Appendix G, Lower Mississippi Region Comprehensive Study.

The conclusions that can be drawn are:

1. If the demands for forest products are met in the basin through 2020, forestry efforts must be increased to raise the levels of stocking.

2. If the private landowner is expected to practice forestry, specific incentives must be applied. These incentives should encourage and direct investment monies to forest management practices that can successfully compete with the present alternative investments that are now receiving the investors' attention.

National Forests practice forest management to provide a mix of forest products and other desired services to the general public. Private forest industries and the National Forest generally practice the most intensive management. Forest industry incentive is to produce a manufactured product for sale rather than a raw forest material. The private landowner is dependent upon the sale of raw material from his forests to provide income.

Economics dictate the lack of interest in forest management on private lands. As can be clearly shown by table 4.23, returns from other agricultural crops result in a much higher return per acre. In addition, the private landowner must wait from 30 to 50 years for returns from forestry investments. Risks from losses by fire, insect, and disease extend over this period. Other reasons are: (1) landowner investment money is limited, (2) the limited money is invested where the landowners can derive a faster return, (3) very little if any available money is left to invest in land use that gives little return.

Future Needs - Present management is producing 44 cubic feet per acre per year and is projected to produce 55 cubic feet per acre per year by 2020 compared with a maximum potential of 86 cubic feet per acre per year (figure 3.4). However, the projected demand for wood by 2020 is expected to be 68 cubic feet per acre per year (figure 3.3), leaving a deficit of 13 cubic feet per acre compared to present levels of management. Present management needs to be intensified on some areas in the near future so that demand will not exceed supply (figure 3.3).

Projected demands of 138 million cubic feet (figure 3.2) of wood by 2020 can be met as follows: (1) forestland use projection of 2,534,700 acres less 287,000 acres for parks, floodways, wildlife refuges and waterfowl areas are presently producing 55 cubic feet per acre per year or 123.6 million cubic feet; and (2) a complement of 14.6 million cubic feet can be obtained by treating 84,000 acres with timber stand improvement and planting trees on 173,000 acres of poorly stocked areas of uplands, which make up the Y-LT Project.

Table 4.23. Comparison of annual net dollar return per acre for forest products to other agricultural crops on the same type of land, Yazoo-Mississippi River Basin, 1970

Type of land	Forest products	Annual net return/acre	Other agricultural crops	Annual net return/acre
		Dollars		Dollars
Bottomland hardwood	Sawlogs and pulpwood	13.00	Soybeans	62.00
Bottomland hardwood	Sawlogs and pulpwood	13.00	Rice	52.00
Upland hardwood and pine	Sawlogs and pulpwood	11.00	Cotton	66.00
Upland hardwood and pine	Sawlogs and pulpwood	11.00	Corn	33.00
Upland hardwood and pine	Sawlogs and pulpwood	11.00	Pasture	19.00

Source: Forest Service, United States Department of Agriculture.

Three alternative rates of forest resource development are considered in this study. These alternatives are:

1. No development - This rate of development is based on 1970 production rates held constant for the 50-year period 1970 through 2020.

2. National Economic Development - This rate is OBERS projections adjusted to the hydrologic basin boundary.

3. With Accelerated Development - This rate of development is a 12 percent acceleration above OBERS projections for 1980, 2000, and 2020.

Demands for forest products are based on projected populations for 1980, 2000, and 2020. These demands are the share of the total national demand allocated to the basin (OBERS projections) and are the same for all alternatives considered. The projected demands are 86 million cubic feet for 1980, 117 million cubic feet in the year 2000, and 138 million cubic feet in 2020. The acreage needs to meet projected demands under the three alternatives are listed in table 4.24.

Table 4.24. Forest land needs to meet the demands for forest products, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year	OBERS demands	Without development program 1/	With development program 2/
	Acres	Acres	Acres
1970	1,693,000	1,693,000	1,693,000
1980	1,713,000	1,968,000	1,530,000
2000	2,272,000	2,677,000	2,028,000
2020	2,509,000	3,158,000	2,240,000

Source: Forest Service, United States Department of Agriculture.

1/ Based on 1970 production and meeting OBERS demands.

2/ Based on 12 percent acceleration of expected production (figure 3.4) and OBERS demands.

Additional forest land needs, including wildlife habitat, forage production, watershed protection, recreation, scenic values, and environmental values are covered in other sections of this chapter (figure 4.1). For the most part these uses are compatible with timber production. Depending on the degree of development and use, some uses such as recreation, scenic values, and some environmental values may limit timber production. There is a need to reserve these acres for future development in an early action program.

Flooding

Flooding is a major problem in the Yazoo-Mississippi River Basin. The principal floodwater damages are to agricultural lands although roads, bridges, residences, businesses, and industrial property are subject to floodwater damages.

Flooding in the basin generally occurs in the winter and spring months. However, local flooding may occur at any time of the year. The floods may result from the runoff of a single storm having duration of a few days or a series of storms extending over a period of several months. The occurrence and intensity of flooding are affected by seasonal upstream conditions influencing the Mississippi River as well as local storm conditions and drainage patterns. Basin flooding can be classified as two distinct types, headwater and backwater.

Figure 4.1: Other forest values

WILDLIFE

WATER QUALITY

SCENIC & RECREATION

FORAGE

Tributary streams are subject to overflow when storms of considerable duration or short but intense storms cause local and upstream drainage areas to produce excessive runoff. Flooding along upstream flood plains is caused by excessive local runoff and may be increased where local channels are poorly developed. Flooding along the principal streams is caused by increased discharges from upstream watersheds and large amounts of local runoff.

Alluvial lands in the southern part of the basin are subject to flooding from high stages in the Mississippi River. These high stages cause backwater flow to inundate local unprotected areas and also to "back up" tributary channels where it combines with channel flow to cause flooding in unprotected upstream areas.

Generally widespread flooding in the basin occurred in 1927, 1932, 1948, 1961, 1969, and 1973. The flood of 1927 was the most disastrous in the recorded history of the basin. Rains fell for months over 31 states and two Canadian Provinces drained by the Mississippi River. Record stages caused the Mississippi River levees to crevasse in several places, allowing floodwaters to spread over much of the area. Over 2 million acres of fertile alluvial land were inundated. Cities, towns, and farms were flooded, crops were destroyed, and industries paralyzed. The flood resulted in an estimated $43 million damage and accounted for 60 deaths. Evacuation of thousands of persons from flooded areas prevented even greater loss of life.

The 1932 flood was the result of a series of storms which occurred from November 17, 1931, to February 21, 1932. During this period, rainfall at Swan Lake, Mississippi, measured 51 inches, which is almost equal to the total for a normal year. Approximately 1.1 million acres were inundated, resulting in damages amounting to $1.4 million.

The flood of February 1948 was caused by unusually heavy rains in the Yazoo Basin. Over a three day period, amounts of rainfall varied from 8.2 inches at New Albany and Ripley, Mississippi, to 2.5 inches at Vicksburg, Mississippi. The flood overflowed an area of 726 thousand acres and resulted in an estimated $4.6 million damages.

The 1961 flood was the result of heavy rains in April and May. Saturated soil conditions, due to preceding rains, caused maximum runoff during and after the storm's occurrence. Along streams, over 667 thousand acres were flooded with damages estimated at $2.2 million.

The 1969 flood resulted from a storm during the period November 18-19. Rainfall varied from 7.8 inches at Greenville, Mississippi, to 2.1 inches at Rolling Fork, Mississippi. Rainfall over the basin

averaged 4.7 inches. The flood inundated an area of 340 thousand acres and resulted in \$1.8 million damages.

The flood of 1973 will be recorded as one of the most devastating ever to occur in the Yazoo Basin. The flood dramatically shows the devastating effect that flooding can have on people and economy of an area.

Beginning in the fall of 1972, the entire Mississippi Valley experienced heavy rainfall, often torrential in nature, over wide areas. The rains prevented harvest of a significant portion of the 1972 crop. The rainfall kept the soil saturated and began to fill the flood control reservoirs which set the stage for the flooding which was to follow.

As the rainfall continued into the winter months, an ominous pattern began to take shape in hydrograph readings of the Mississippi River. By December the river was assuming a typical pre-flood pattern somewhat ahead of the stage developments which preceded the great flood of 1927.

As the Mississippi River was still rising, torrential rains occurred on March 15 and 16. Spectacular totals of almost 10 inches for the two-day period were recorded at some stations. Sardis, Enid, and Grenada Reservoirs all flowed over their emergency spillways for the first time in history. Later, Arkabutla Reservoir flowed over its spillway as the result of other rain periods. Some roads were closed by high water, bridge washouts, and mud slides.

Flash flooding from the torrential rains was a problem in a number of urban areas. Hardest hit were Vicksburg and Greenwood, Mississippi. Cleanup operations continued for weeks in some areas.

As the swollen Yazoo River inundated large delta areas, the rains continued for several weeks, making it impossible for many farmers even in fields above the high water to prepare for planting. As the Mississippi River rose higher and higher, more and more of the backwater areas were flooded. An approximate 1,050-square-mile area north of Vicksburg was affected. Most of the damage in this area was agricultural, but many homes were flooded-particularly in outlying areas of Vicksburg.

The flood of 1973 had the second longest duration of any Mississippi River flood of record. This was particularly distressing to farmers who were unable to plant any crops or were forced to plant substitute crops with lower returns. Some families were forced out of their homes for months and many homes were severely damaged or destroyed as a result of the long duration of the flood.

Total damages from this 1973 flood were estimated to be $169.4 million with about $134.6 million or 79 percent being agricultural. Damages to urban areas amounted to about $15.8 million or 9 percent of total. Damages to federal property and to roads, bridges, and railroads were high, amounting to $12.2 million or 7 percent of the total, and $4.2 million or 3 percent of the total, respectively. The remainder of the damage ($2.6 million) resulted from rerouting traffic, evacuation, dislocation and rehabilitation, and flood fighting. A total of 1.7 million acres were flooded of which 673 thousand acres were flooded by backwater.

While existing programs and projects do prevent considerable flood damages throughout the basin, there is still considerable damages to agricultural and urban areas.

In the Yazoo-Mississippi River Basin, approximately 4.7 million acres of land or about 55.5 percent of the area is subject to flooding. Of this amount, 2.0 million acres are in upstream watersheds (see table 4.25). The remaining 2.7 million acres are classified as principal streams flooding and this area includes 2.0 million acres of headwater flooding and 724 thousand acres of backwater flooding.

For the upstream watersheds in the basin, the total annual flood damage is approximately $33.6 million. The total annual damages to crops and pasture are approximately $30.3 million, to farm minor fixed improvements $279 thousand, to public roads and bridges $314 thousand, and $2.7 million indirect damage.

Previous field investigations made by the Corps of Engineers indicate a considerable amount of flood damages along the main streams, principal tributaries, and backwater areas of the Yazoo drainage area. This damage is usually infrequent but is high due to the long duration of this type flooding. Damages on principal streams are estimated to be $12.1 million annually. Damages by type and areas for both upland watersheds and principal streams are shown in table 4.26.

Erosion and Sediment

General - Areas of high rates of sheet and gully erosion are usually associated with below average farming potential and depressed areas. The upland subarea of the basin, which is known as the Yazoo and Little Tallahatchie Flood Prevention Project (Y-LT), once displayed some of the most severe erosion in our country. This critical erosion dumped up to 100 million tons of sediment annually into the lowlands. In 1938, over 1.0 million acres of cropland lay destroyed or damaged by erosion. Since 1948 about 75 percent of this land has been restored.

Table 4.25. Upstream watershed areas having floodwater problems, Yazoo-Mississippi River Basin, 1970

Subarea	Total area with flooding problem
	Acres
Alluvial areas outside flood prevention area (Areas 1, 2, 3, 4, 5, 6, 7, and 8W)	1,231,601
Alluvial area within flood prevention area (Area 8E)	276,495
Bluff hills area (Area 9)	79,387
Little Tallahatchie River Upland watershed area (Area 11)	125,065
Yazoo River upland watershed area (Areas 10, 12, and 13)	260, 215
Total area	1,972,763

Source: Soil Conservation Service, United States Department of Agriculture.

Many factors influence erosion rates. Among these are kinds of soils, topography, climate, land use and cover, and management practices including water management. Geologic materials from which soil is developed influence the erodibility of the soils. Soil from loess, alluvium, and sandstone has different factors of erodibility. Soil properties such as organic matter, texture, colloids and base exchange complex tend to hold soil particles together and influence erosion, as do soil depth and profile characteristics.

Topography or the steepness of the land and the length of the slope has a direct effect on erosion rates. As the slope doubles, erosion rates increase about two and one-half times; as the slope length increases ten times, the erosion rate more than doubles.

Some natural erosion occurs in the basin due to climate, specifically rainfall. Large amounts of energy are dissipated in the soil when high intensity rain occurs. This energy loosens the soil particles and erosion starts. Water is the primary transportation agent, although some wind erosion occurs.

Table 4.26. Estimated average annual flood damages, upstream watersheds, and principal streams, Yazoo-Mississippi River Basin, 1970

Subarea	Crops and pastures	Farm fixed improvements	Urban and built-up	Roads and bridges	Indirect	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Upstream areas						
1-8	22,163,721			185,435	2,234,916	24,584,072
9	2,950,748	64,147		64,147	128,293	3,207,335
11	1,403,156	135,244		50,717	101,433	1,690,550
10, 12, 13	3,747,312	79,431		13,449	275,455	4,115,647
Subtotal	30,264,937	278,822		313,748	2,740,097	33,597,604
Principal streams						
Headwater	9,220,000		1,105,000			10,325,000
Backwater	1,579,000		260,000			1,839,000
Subtotal	10,799,000		1,365,000			12,164,000
Total	41,063,937	278,822	1,365,000	313,748	2,740,097	45,761,604

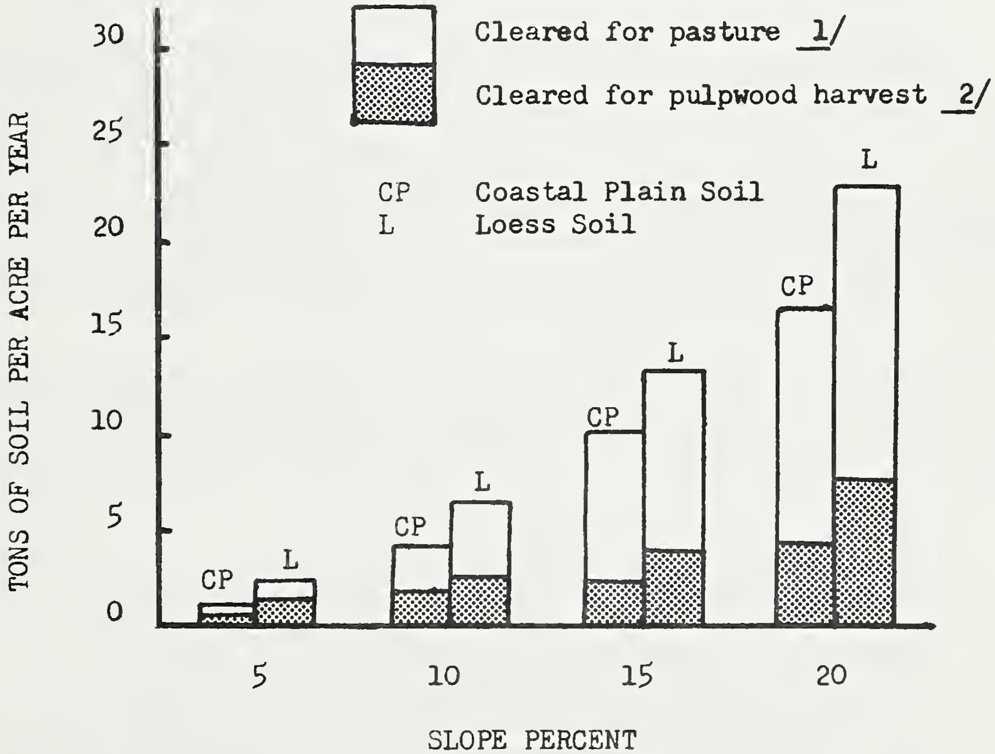
Source: Soil Conservation Service, United States Department of Agriculture and Corps of Engineers, U. S. Army.

Cultivated silty and sandy soils on steep slopes are very erosive. However, all cropland generally erodes at a higher rate than does either pasture or forestland. Good permanent vegetative cover almost eliminates erosion. The cover absorbs most of the rainfall energy and reduces the velocity of runoff. Other local areas, road banks, gullies, and urban developments, have erosion rates that depend on their cover.

Management practices on land determine the amount of cover and the rate of erosion. Practices such as timeliness of operations, fertilization, and crop residue use determine if erosion reduces the productive capacity of the soil. Soil erosion in forestland is influenced by over grazing, poor management, roads, logging trails, and heavy recreation use. Hazards from erosion increase significantly with slope as upland pine plantations are clearcut for harvest and pasture (figure 4.2).

Flooding and water management problems are related to erosion, sediment transport, and sediment deposition. Flooding increases the chance for erosion and flood plain scour and a decreased land resource.

Figure 4.2: Average sheet erosion caused by clearing loblolly pine plantations for pasture as compared to clearing for pulpwood harvest, Yazoo-Little Tallahatchie Flood Prevention Project, 1973



1/ Practice includes soil scarification, fertilization, and seeding to grass

2/ Practice includes removing all merchantable timber with no further treatment

Source: Based on limited data, USDA, Forest Service, Y-LT Flood Prevention Project.

Sediment is transported by water and causes problems. Suspended sediment must be removed from surface water used for municipal and industrial purposes. Also, suspended sediment decreases the water's visual quality and its value for recreation use. Suspended sediment, the largest pollutant of water, is detrimental to biologic and aquatic life systems supported by water. In addition, suspended sediment in water often carries with it soil chemicals, herbicides, pesticides, and fertilizers which may affect the health of humans and animals and plant life using the water.

Sediment is a deterrent to recreation in water stored for recreation use or when deposited on parks and playgrounds. Also, large areas of mud and silt deposits are unattractive. Sedimentation may completely destroy fish breeding habitats.

Sedimentation, as well as channel bed movement is a constant threat to navigation and requires regular monitoring and maintenance in navigation channels. Where deposition is excessive, it also fills waterways and increases flood hazards.

Deposition of sediment is influenced by the velocity of the moving water and the size of the sediment. Damages caused by sedimentation include deposits of sterile overwash, swamping or ponding of water on certain lands, increased areas of inundation, increased streambank erosion, scour or erosion of certain floodplain lands, damaged transportation and reservoir facilities, impaired drainage, higher water tables, deposition on crop, pasture, and forest lands, destruction of wildlife habitats, and degradation of aquatic life.

Activities, other than agriculture, that contribute large sediment yields are dredging of navigation and drainage channels, road and highway construction, strip-mining, urban development, ditch construction, excessively heavy recreation use, and fires that destroy the vegetative cover.

Present Status - Approximately 2.9 million acres of land (subclass "e") in the basin are presently affected by erosion and occurs as sheet, gully, and roadbank erosion and as floodplain scour (table 4.27). Additionally, it is estimated that approximately 2.8 thousand miles of streambank throughout the basin are subject to erosion damage. Almost 28.4 million tons of sediment are produced annually in the basin by all forms of erosion, averaging nearly 3.3 tons per acre per year for the total area of the basin and causing almost $6.3 million in damages.

The estimated average annual gross erosion in tons per square mile, the average annual sediment yield in tons per square mile, and the concentration of suspended sediment in milligrams per liter (mg/l) for the basin and for each area are shown in table 4.28.

Table 4.27. Sediment and erosion problems and damages, Yazoo-Mississippi River Basin, 1970

Erosion	Unit	Amount
Land area affected		
Sheet	1,000 acres	2,868.4
Gully	1,000 acres	9.1
Floodplain scour	1,000 acres	0.6
Roadbank	1,000 acres	8.2
Streambank	Miles	2,767.0
Gross erosion by source		
Sheet	1,000 tons	14,913.1
Gully	1,000 tons	1,046.7
Floodplain scour	1,000 tons	12.7
Roadbank	1,000 tons	708.7
Streambank	1,000 tons	11,710.9
Average annual damages	1,000 dollars	6,288.0

Source: Soil Conservation Service, United States Department of Agriculture.

Table 4.28. Estimated average annual gross erosion and sediment yield by subareas, Yazoo-Mississippi River Basin, 1970

Subarea	Total area	Estimated average annual gross erosion	Estimated average annual yields	Estimaged average annual suspended sediment concentration
	Sq. Mi.	Tons/Sq. Mi.	Tons/Sq. Mi.	mg/l
Delta				
1-8	6,661.25	86	9	> 10
Upland				
9	2,368.15	5,721	3,723	2,283
10	922.24	4,379	1,666	1,022
11	1,458.13	2,660	1,317	713
12	624.22	2,816	1,230	808
13	1,320.69	3,480	2,079	1,366
Total	13,354.68	2,126		

Source: Soil Conservation Service, United States Department of Agriculture.

Additional information on the percentage of land area affected by erosion and the gross erosion in average tons per acre per year for each area is shown in table 4.29. The percentage of dollars damage from present erosion and sediment by type for each subarea is shown in table 4.30.

Table 4.29. Percentage of land area affected by erosion and average gross erosion of affected areas, Yazoo-Mississippi River Basin, 1970

Subarea	Land area affected	Average annual gross erosion
	Percent	Tons/acre/year
1-8	6.3	2.1
9	70.4	12.7
10	70.6	9.7
11	73.1	5.7
12	73.1	6.0
13	66.3	8.2

Source: Soil Conservation Service, United States Department of Agriculture.

Table 4.30. Percentages of dollars damage from present erosion and sediment by type, Yazoo-Mississippi River Basin, 1970

Subarea	Sediment	Scour	Roadside erosion	Streambank erosion
	Percent			
1-8	0	0	0	100
9	69	1	1	29
11	39	4	1	56
10, 12, 13	49	3	1	47

Source: Soil Conservation Service, United States Department of Agriculture.

The present land use of areas affected by erosion in the basin is 16 percent cropland, 20 percent pasture, 62 percent forest land, and 2 percent other land.

Future Needs - Natural erosion process and the accelerated erosion caused by man are inseparable. Natural erosion has altered the natural resources and the environment since the beginning of time. The deep alluvial materials in the delta and the widespread loessal uplands in the basin were deposited, eroded, and redeposited over many thousands of years under extremely different vegetative and climatic regimes. Compared to these amounts of erosion and sedimentation, man, in his short time, has not significantly altered the landscape. However, in some places he has drastically increased the rates of erosion and sedimentation as compared to the natural processes and has completely changed the environment and natural resources to conditions that would not have existed naturally.

Future estimates for sediment and erosion problems and damages are presented in table 4.31. The area affected by erosion is projected to decline from 2.9 million acres in 1970 to 2.7 million acres in 2020. Average annual damages are projected to increase from $6.3 million in 1970 to $10.6 million in 2020. The increased damages are a result of more intensive land use and higher damageable values per acre.

Table 4.31. Future sediment and erosion problems and damages, Yazoo-Mississippi River Basin, 1980, 2000, and 2020

Erosion	Unit	1980	2000	2020
Land area affected:				
Sheet	1,000 acres	2,865.6	2,811.6	2,748.6
Gully	1,000 acres	9.0	8.9	8.8
Floodplain scour	1,000 acres	0.3	0.3	0.3
Roadbank	1,000 acres	8.1	7.8	7.6
Streambank	Miles	2,767.0	2,767.0	2,767.0
Extent of erosion				
Sheet	1,000 tons	13,888.6	12,751.1	11,381.6
Gully	1,000 tons	750.6	464.8	414.1
Floodplain scour	1,000 tons	6.3	6.3	6.1
Roadbank	1,000 tons	280.0	173.8	123.9
Streambank	1,000 tons	10,539.8	8,783.1	5,855.4
Average annual damages	1,000 dollars	8,718.0	9,646.0	10,589.0

Source: Soil Conservation Service, United States Department of Agriculture.

Lands With a Wetness Hazard

General - These are wetlands with either a surface or internal drainage problem. They are usually lowlands covered with shallow and sometimes temporary or intermittent waters, often referred to as swamps, bogs, wet meadows, potholes, sloughs, and river overflow lands.

When considered strictly in the light of land drainage, wetland is often thought of as land on which excess water imposes limitations to some of its potential uses. It is land characterized by being constantly or periodically submerged or of having a constant or occasional high water table. Within the scope of this definition, wetlands include existing agricultural lands on which excess water inhibits optimum agricultural production, overflow plains of streams, and such other tracts of low, wet, soft land variously known as swamps, marshes, and bogs.

Wetlands can be drained or filled to create land for agricultural, industrial, or residential expansion, or for purposes of vector control and other uses.

Present Status - Presently there are 4.2 million acres of land in the basin that have a wetness hazard. This hazard varies in intensity and may be internal or external. Table 4.32 shows this land by land capability classes and subclasses for the year 1970. Table 4.33 gives this same information by land resource areas.

Table 4.32 shows that approximately 1.4 million acres of land need to be drained, all of which is now cropland. Drainage is needed on this land to meet the demand for food and fiber and for efficiency in production.

Future Needs - Future drainage needs in the basin for 1980, 2000, and 2020 are approximately 1.9 million acres, 2.1 million acres, and 2.2 million acres, respectively. Table 4.34 shows the expected future needs for drainage. In the future, some of the land with a remaining wetness hazard and needing drainage is expected to continue to be used for pasture and forage production.

Recreation

The diverse topography, ranging from the nearly flat delta, through the bluff hills, to the rolling uplands, provides a variety of recreation opportunities in the basin.

The delta portion offers developed public facilities, consisting of one state park and one developed National Forest site, a National

Table 4.32. Acres of land by major land use, capability class and subclass that have a wetness hazard, Yazoo-Mississippi River Basin, 1970

Land use	Class and subclass							
	IIw	IIIw	IVw	Vw	VIw	VIIw	VIIIw	Total
	1,000 acres							
Crops								
Wetness hazard	800.0	1,336.3	477.8	35.1	1.7	0	0	2,650.9
Drainage needed	282.7	747.4	366.4	27.4	1.7	0	0	1,425.6
Pasture								
Wetness hazard	172.3	101.1	62.7	2.4	0.4	0	0	338.9
Drainage needed	0	0	0	0	0	0	0	0
Forest								
Wetness hazard	197.3	341.3	397.4	84.6	12.8	0	0	1,033.4
Drainage needed	0	0	0	0	0	0	0	0
Other								
Wetness hazard	48.1	43.5	30.6	1.1	0	0	0	123.3
Drainage needed	0	0	0	0	0	0	0	0
Total								
Wetness hazard	1,217.7	1,822.2	968.5	123.2	14.9	0	0	4,146.5
Drainage needed	282.7	747.4	366.4	27.4	1.7	0	0	1,425.6

Source: Soil Conservation Service, United States Department of Agriculture.

Table 4.33. Acres of land that have a wetness hazard by major land resource areas and major land use, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000 and 2020

Land resource area	Cropland	Pasture	Forest	Other	Total
	1,000 acres				
1970					
131	2,177.6	112.4	760.5	86.3	3,136.8
133	211.7	86.9	105.2	23.1	426.9
134	261.6	139.6	167.7	0	582.8
Total	2,650.9	338.9	1,033.4	123.3	4,146.5
1980					
131	2,535.9	119.9	410.3	72.5	3,138.6
133	263.3	89.0	60.2	16.4	428.9
134	336.8	141.5	101.9	8.4	588.6
Total	3,136.0	350.4	572.3	97.3	4,156.0
2000					
131	2,644.7	120.3	327.1	66.4	3,158.5
133	280.6	89.0	37.2	14.0	420.8
134	334.8	141.5	75.5	6.8	558.6
Total	3,260.1	350.8	439.8	87.2	4,137.9
2020					
131	2,701.0	128.0	261.0	43.6	3,133.6
133	301.2	76.6	30.2	7.7	415.7
134	384.5	136.9	51.3	4.4	577.1
Total	3,386.7	341.5	342.5	55.7	4,126.4

Source: Soil Conservation Service, United States Department of Agriculture.

Wildlife Refuge and other county parks and public landing areas on large lakes. It also offers the beauty of bottomland hardwoods along with natural oxbow lakes. Some of these are McIntyre Scatters, Matthews Brake, Sharkey Bayou, Mossy Lake, Eagle Lake, and Wolf Lake. The Delta National Forest contains 59 thousand acres that are available for dispersed recreation. Winterville Mounds is a historic site featuring advanced Indian mounds and a museum near Greenville. The site is maintained by the Mississippi Parks Commission and receives heavy use by both tourists traveling through the basin and students from local schools for educational purposes.

The bluff hills are a unique land feature formed by wind blown soils (loessal soils). The natural vegetation is oak-hickory forests including yellow poplar, black walnut, black cherry, dogwood,

Table 4.34. Lands with a wetness hazard, drainage already applied or not needed, and drainage needed by major land use, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year and land use	Land with a wetness hazard	Drainage applied or not needed	Drainage needed
	1,000 acres		
1970			
Cropland	2,650.9	1,225.3	1,425.6
Pasture	338.9	338.9	0
Forest	1,033.4	1,033.4	0
Other	123.3	123.3	0
Total	4,146.5	2,720.9	1,425.6
1980			
Cropland	3,136.0	1,224.6	1,911.4
Pasture	350.4	327.3	23.1
Forest	572.3	572.3	0
Other	97.3	97.3	0
Total	4,156.0	2,221.5	1,934.5
2000			
Cropland	3,260.1	1,224.7	2,035.4
Pasture	350.8	327.3	23.5
Forest	439.8	439.8	0
Other	87.2	87.2	0
Total	4,137.9	2,079.0	2,058.9
2020			
Cropland	3,386.7	1,217.8	2,168.9
Pasture	341.5	297.4	44.1
Forest	342.5	342.5	0
Other	55.7	55.7	0
Total	4,126.4	1,913.4	2,213.0

Source: Soil Conservation Service, United States Department of Agriculture.

hickory, and oak. The area does not contain any major developed recreation sites, but receives use for pleasure driving, sightseeing, bird watching, and other dispersed type recreation. The area does contain the Vicksburg National Military Park and Cemetery which is the famed site of the siege of Vicksburg during the Civil War.

The major portion of the public recreation development is in the upland portion of the basin. This area contains four large flood control reservoirs built by the Corps of Engineers. Around

these reservoirs are four state parks and an additional 22 areas developed and managed by the Corps of Engineers. Facilities are provided for camping, picnicking, fishing, swimming, and boating. Facilities on three of the lakes, Arkabutla, Sardis, and Enid, receive a heavy influx of use from the City of Memphis, Tennessee. One other state park is located near Holly Springs.

Holly Springs National Forest in the upland portion provides three developed sites with facilities for camping, picnicking, swimming, boating, and fishing. It contains 140 thousand acres available for dispersed recreation use. See table 4.35 for a listing of public outdoor facilities.

Although complete information generally is not available as to the location of private recreation facilities, these facilities play an important role in satisfying recreation needs within the basin. Like public facilities, the major portion of private recreation developments is located in the uplands portion of the basin.

The basin contains 53 percent of the developed recreation acreage in Mississippi and receives about 30 percent of the state's annual use. In addition to resident use, there is a heavy influx of non-resident use primarily from the metropolitan area of Memphis, Tennessee. No accurate figures exist to describe this demand generated outside the basin.

Present Status - There are presently about 72 thousand acres of surface water and 26 thousand acres of land devoted to selected outdoor recreation use in the basin. These facilities have the capability to provide over 34 million recreation activity occasions per year. A recreation activity occasion is defined as the participation by one person in one activity during a day. If a person participates in three different activities in one day, it is three activity occasions. The existing supply of recreation facilities is listed in table 4.36 by type of facility, number of units, acres, capability in activity occasions, and type of ownership.

For the purposes of allocating land for future recreation development, all recreation uses considered in this study were grouped under an appropriate land use category. The categories utilized are urban and built-up, other lands, forest lands, and large water. The basin's recreation facilities are listed under the appropriate land use category by units, acres, and activity occasions in table 4.37. Other lands contain the least amount of recreation development with 138 acres of swimming beaches accounting for 3.9 million activity occasions. Large water accounts for the greatest use with 72.7 thousand acres and 14.1 million activity occasions. Urban and built-up provides 7.6 thousand acres and 12.3 million activity occasions. Forest lands contain 18.0 thousand acres of developed sites providing 3.8 million activity occasions.

Table 4.35. Recreation, fish, and wildlife facilities, Yazoo-Mississippi River Basin

Name of Project	Agency	Location (County)	Project Use	Description 1/
Arkabutla Lake	Corps of Engineers	DeSoto, Tate	R, F&W, FC	Completed 1943. High F&W rating. 11,870 ac. Reservoir High fish. & waterfowl use. Rec. Facs. incl. camping (80 units), picnicking (231 units), 5 boat launching ramps, 16 comfort stations & swimming beach.
Sardis Lake	Corps of Engineers	Panola, Lafayette Marshall	R, F&W, FC	31,000-ac. reservoir. High fishing & waterfowl use. Rec. Facs. incl. camping (353 units), picnicking (374 units), 14 boat ramps, 23 comfort stations, and 3 swimming beaches.
Enid Lake	Corps of Engineers	Panola, Lafayette Yalobusha	R, F&W, FC	Completed 1952. High F&W rating. 16,800 ac. Reservoir High fishing & waterfowl use. Rec. Facs. incl. camping (205 units), picnicking (259 units), 11 boat launching ramps, 27 comfort stations, & a swimming beach.
Crenada Lake	Corps of Engineers	Grenada, Yalobusha Calhoun	R, F&W, FC	Completed 1954. High F&W rating. 34,310 ac. Reservoir High fish. & waterfowl use. Rec. facs. incl. camping (202 units), picnicking (317 units), 15 boat launching ramps, 25 comfort stations, and a swimming beach.
Carver Point State Park	Miss. Park Comm.	Grenada	R, F&W	750 ac. Fishing. Located on Crenada Lake. Rec. facs. incl. swimming, boating, picnicking, camping (cabins, group camps).
Holmes County State Park	Miss. Park Comm.	Holmes	R, F&W	Rec. facs. incl. camping (cabins, group camp, tent-trailer), swimming, boating, picnicking, & nature trails. 463 ac.
Coldwater Public Access Area	Miss Game & Fish Comm.	Quitman	R, F&W	Public access. Launching ramp. 1-ac. site.
Dumas Lake	Miss. Game & Fish Comm.	Tippah	F&W	High F&W rating. 32 ac. Public owned & managed fishing lake. Receives intensive use.
Eagle Lake Public Access Area	Miss. Game & Fish Comm.	Warren	R, F&W	Public access. Launching ramp.
Crenada Waterfowl Area	Miss. Game & Fish Comm.	Yalobusha	F&W	High F&W rating. About 7,500 ac. equivalent. Area used by waterfowl & waterfowl hunters. Incl. open lake water.
Grenada State Refuge	Miss. Game & Fish Comm.	Calhoun	F&W	High F&W rating. 2,750 ac. Waterfowl refuge, good fishing use, high WOR usage.
Indian Bayou Waterfowl Area	Miss. Came & Fish Comm.	Sharkey	F&W	High F&W rating. 500 ac. greentree area. High waterfowl use. No fish.
Issaquena Wildlife Mgmt. Area	Miss. Game & Fish Comm.	Issaquena	F&W	High F&W rating. 13,000 ac. Some waterfowl & fishing use.
Lake Washington Public Access	Miss. Came & Fish Comm.	Washington	R, F&W	Public access & launching ramp.
Leflore County Waterfowl Area	Miss. Game & Fish Comm.	Leflore	F&W	High F&W rating. 350 ac. greentree area. High waterfowl area.
Malmaison River Wildlife Mgmt. Area	Miss. Came & Fish Comm.	Crenada	F&W	High F&W rating. 8,000 ac. Cood waterfowl use, fishing.
Moon Lake Public Access Area	Miss. Game & Fish Comm.	Coahoma	R, F&W	Public access & launching ramp.
O'Keefe Waterfowl Area	Miss. Game & Fish Comm.	Quitman	F&W	High F&W rating. 5,000 ac. waterfowl area. 800 ac. greentree area. High waterfowl use.
Sardis Waterfowl Area	Miss. Game & Fish Comm.	Lafayette	F&W	High F&W rating. Approx. 5,200-ac. hunting area, incls. open lake water.
Sardis Waterfowl Refuge	Miss. Game & Fish Comm.	Lafayette	F&W	High F&W rating. 1,800-ac. waterfowl refuge. High WOR use.
Sunflower Wildlife Mgmt. Area	Miss Game & Fish Comm.	Sharkey	F&W	High F&W rating. 59,000 ac. Partial greentree. High fishing, waterfowl & WOR use. Coincides with Delta Natl. Forest
Sunflower Waterfowl Area	Miss. Game & Fish Comm.	Yazoo	F&W	High F&W rating. 1,600 ac. greentree area. High waterfowl use

continued --

Table 4.35. Recreation, fish, and wildlife facilities, Yazoo-Mississippi River Basin (continued)

Name of Project	Agency	Location (County)	Project Use	Description 1/
Tallahatchie River Public Access Area	Miss. Game & Fish Comm.	Panola	R, F&W	Public access with launching ramp.
Upper Sardis Reservoir Wildlife Mgmt. Area.	Miss. Game & Fish Comm.	Marshall, Lafayette	F&W	High F&W rating, 4,700-ac. equivalent. Waterfowl area includes open lake.
Arkabutla Public Access Area	Corps of Engineers	Tate	R, F&W	Public access area, launching ramp.
Grenada Public Access Area	Corps of Engineers	Grenada	F&W	Public access and launching ramp.
Delta Natl. Forest	U. S. Forest Svc.	Sharkey, Issaquena	R, F&W	High F&W rating. 59,000 ac. Large tract bottomland hardwood, one of few in entire Miss. R. alluvial valley. High use for waterfowl, one greentree reservoir 1,700 ac., fish & WOR. 2 rec. areas (8 units) for camping, picnicking, fishing, boating, and hiking. Some stands of virgin timber.
Holly Springs Natl. Forest	U. S. Forest Svc.	Marshall, Lafayette, Benton, Union, Tippah, Pontotoc, Yalobusha	R, F&W	Moderate to high F&W rating. Approx. 140,000 ac. Fishing & some waterfowl use in bottomlands. Primarily upland areas. 3 rec. areas for camping (76 units, picnicking (65 units), fishing, boating, swimming, and hiking.
Eagle Lake		Warren, Issaquena	R, F&W	High F&W rating. 4,600 ac. Miss. R. oxbow lake. Known nationally for fine game fish. Good waterfowl use. Considerable WOR use.
Lake Bolivar		Bolivar	R, F&W	High F&W rating. 662 ac. Miss. R. oxbow lake. High fish & waterfowl.
Lake Washington		Washington	R, F&W	High F&W rating. 2,938 ac. Miss. R. oxbow lake. High fish. & waterfowl use.
Hugh White State Park	Miss. Park Comm.	Grenada	R, F&W	740 ac. located on Grenada Lake. Fishing use. High WOR use.
John Kyle State Park	Miss. Park Comm.	Panola	R, F&W	740 ac. located on Sardis Lake. Fishing & WOR useage. Rec. facs. incl. camping (cabins, group camp, tent-trailer), swimming, boating, picnicking, & nature trails.
Leroy Percy State Park	Miss. Park Comm.	Washington	R, F&W	2,422 ac. Good fishing. High WOR use. Rec. facs. incl. camping (cabins, group camp, tent-trailers), swimming, boating, picnicking, & nature trails.
Wall Doxey State Park	Miss. Park Comm.	Marshall	R, F&W	Rec. facs. including camping (cabins, group camp, tent-trailer), fishing, swimming, boating, picnicking, & nature trails. 855 ac.
Winterville State Park	Miss. Park Comm.	Washington	A&H, F&W*	Low F&W rating. 40 ac. No hunting or fishing. Indian mounds and museum.
Yocona Ridge State Park	Miss. Park Comm.	Yalobusha	R, F&W	Rec. facs. including boating, picnicking, camping, (tent-trailer) & nature trails. 825 ac.
Vicksburg National Military Park and Cemetery	National Park Svc.	Warren	R, A&H, F&W*	Low F&W rating. 1,740 ac. High WOR use. No fishing or hunting. Civil War Battleground, Museum. Tours of Battlefield.
Arkabutla Waterfowl Refuge	Miss. Game & Fish Comm.	Tate	F&W	High F&W rating. 2,200 ac. waterfowl refuge. High WOR use.
Calhoun County Wildlife Mgmt. Area	Miss. Game & Fish Comm.	Calhoun	F&W	Moderate F&W rating. 9,000 ac. No water use. No fishing.
Moon Lake		Coahoma	R, F&W	High F&W rating. 1,800 ac. Miss. R. oxbow lake. High waterfowl & fishing use.
Hillside Floodway	Corps of Engineers	Holmes	F&W	High F&W rating. Proposed national wildlife refuge, primarily waterfowl. 15,600 ac.
Yazoo Natl. Wildlife Refuge	U. S. Department of the Interior	Washington	F&W	High F&W rating. 12,470 ac. No waterfowl hunting as it is a waterfowl refuge. Some fishing. High WOR use.

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ R = Recreation; FC = Flood Control; WOR = Wildlife Oriented Recreation; F&W = Fish and Wildlife - Consumptive Use; F&W* = Fish and Wildlife - Non-consumptive; A&H = Archaeological and Historical.

Table 4.36. Existing supply of selected recreation facilities by type of facility, ownership, units, acres, and capability in activity occasions, Yazoo-Mississippi River Basin, 1970

Type of facility	Unit of Measure	Public facilities			Non-Public facilities			Total facilities		
		Units	Acres	Activity occasions	Units	Acres	Activity occasions	Units	Acres	Activity occasions
Swimming (pools)	Sq. ft.	227,465	5	727,888	422,435	10	1,351,792	649,900	15	2,079,680
Swimming (beaches)	Sq. ft.	3,617,222	83	2,315,022	2,411,482	55	1,543,349	6,028,704	138	3,858,371
Playing fields	Acres	543	543	2,280,600	1,465	1,465	6,153,000	2,008	2,008	8,433,600
Picnic sites	Tables	2,835	354	1,047,816	848	106	313,421	3,683	460	1,361,237
Tent camp sites	Sites	215	27	59,598	1,323	165	366,736	1,538	192	426,334
Trailer campsites	Sites	1,160	145	375,144	988	124	319,519	2,148	269	694,663
Group camps	Beds	600	50	25,200	3,398	113	142,716	3,998	163	167,916
Golf course (9 hole)	Course	6	480	116,640	27	2,160	524,880	33	2,640	641,520
Golf course (18 hole)	Course	7	1,120	231,336	6	960	198,288	13	2,080	429,624
Tennis courts	Court	51	13	97,920	82	21	157,440	133	34	255,360
Horse trails	Miles	57	2,850	239,400	199	9,950	835,800	256	12,800	1,075,200
Hiking trails	Miles	11	275	5,082	65	1,625	30,030	76	1,900	35,112
Nature trails	Miles	17	425	5,440	72	1,800	23,040	89	2,225	28,480
Bicycle trails	Miles	15	375	216,000	19	475	273,600	34	850	489,600
Boat docks (water)	Boat slips	66	1/	17,424	486	1/	128,304	552	1/	145,728
Boating (water area)	Acres	66,157	66,157	6,351,072	6,543	6,543	628,128	72,700	72,700	6,979,200
Boating (water ski)	Acres	66,157		6,351,072	6,543		628,128	72,700		6,979,200
Totals			72,902	20,462,654		25,572	13,618,171		98,474	34,080,825
Land			6,745	7,743,086		19,029	12,233,611		25,774	19,976,697
Water			66,157	12,719,568		6,543	1,384,560		72,700	14,104,128

Source: Tabulated from the Mississippi Statewide Comprehensive Outdoor Recreation Plan.
1/ Acreage included in water area for boating.

Table 4.37. Distribution of existing recreation facilities by land use categories expressed in units, acres, and activity occasions, Yazoo-Mississippi River Basin, 1970

Land use category and recreation facility	Unit of measure	Units	Acres	Activity occasions
Urban and built up				
Swimming (pools)	Sq. ft.	649,900	15	2,079,680
Playing fields	Acres	2,008	2,008	8,433,600
Golf course (9 hole)	Course	33	2,640	641,520
Golf course (18 hole)	Course	13	2,080	429,624
Tennis courts	Courts	133	34	255,360
Bicycle trails	Miles	34	850	489,600
Total			7,627	12,329,384
Other lands				
Swimming (beaches)	Sq. ft.	6,028,704	138	3,858,371
Total			138	3,858,371
Forest land				
Picnic sites	Tables	3,683	460	1,361,237
Tent camp sites	Sites	1,538	192	426,334
Trailer camp sites	Sites	2,148	269	694,663
Group camp sites	Beds	3,998	163	167,916
Hiking trails	Miles	76	1,900	35,112
Horse trails	Miles	256	12,800	1,075,200
Nature trails	Miles	89	2,225	28,480
Total			18,009	3,788,942
Large water				
Boat docks	Boat slips	552	1/	145,728
Boating (water area)	Acres	72,700	72,700	6,979,200
Boating (water ski)	Acres			6,979,200
Total			72,700	14,104,128

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Acreage included in water area for boating.

Future Needs - The greatest problem is that demand for outdoor recreation out-strips the existing supply of some facilities. This problem is compounded by demands from outside the basin primarily from the metropolitan area of Memphis, Tennessee. It is difficult to assess and plan for this demand. State recreation development plans are based on meeting only those needs generated within the state. This same base is used to assess recreation demands and needs for the Yazoo-Mississippi River Basin. The assumption is made that for each influx of recreation use from outside the basin, an equal number of basin residents would seek recreation outside of the basin.

Minor problems are distribution of present facilities and land ownership patterns. Since most recreation development is either water-based or water related, the bulk of recreation development is located around large lakes in the uplands portion of the basin. This places certain types of recreation such as boating and water skiing out of easy access to a large portion of the basin's population. Future development can be geared to meeting this need by locating recreation facilities within easy access of population centers.

Ownership patterns may present problems in meeting the demands for trails. Horse trails and hiking trails require a continuous ownership pattern for as much as 30 miles. There are not enough suitable sites on federal lands within the basin to meet all of the demands for trails. Much of this development must be on private lands. This will require direct acquisition or long term leasing agreements to reserve adequate sites for trail development.

The supply, demand, and net needs for recreation are shown in table 4.38, by activity occasions in table 4.39, and by acres and facilities in table 4.40.

Tourism

The Yazoo Basin offers a wide variety of interesting and entertaining attractions to visitors. Its three centuries of history include the antebellum era, steamboats on the river, delta plantations, and Civil War battlesites and parks.

Although there has been a substantial amount of archeological research done in the basin, there are still great gaps in the knowledge of prehistoric occupation. There are Indian mounds built about 700 A.D. on the Mississippi River banks near Lula, the Winterville Mounds near Greenville date back to about 1000 A.D., and the Jaketown Site, near Belzoni, to about 1000 B.C.

Table 4.38. Demand, supply, and net needs for selected recreation facilities, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Recreation Facility	Unit of Measure	1970			1980		2000		2020	
		Supply	Demand	Net needs	Demand	Net needs	Demand	Net needs	Demand	Net needs
Swimming (pool)	Sq. ft.	649,900	1,045,440	395,540	1,089,000	439,100	1,219,600	569,700	1,437,480	787,580
Swimming (beach)	Sq. ft.	6,028,704	2,787,840	0	2,874,960	0	3,223,440	0	3,876,840	0
Play fields	Acres	2,008	10,039	8,031	10,254	8,246	11,623	9,615	13,941	11,933
Picnic sites	Tables	3,683	10,680	6,997	10,912	7,229	12,368	8,685	14,840	11,157
Tent camping	Sites	1,538	1,152	0	1,176	0	1,336	0	1,600	62
Trailer camping	Sites	2,148	1,264	0	1,288	0	1,464	0	1,752	0
Group camping	Beds	3,998	3,150	0	3,210	0	3,630	0	4,350	352
Golf (9 hole)	Course	33	9	0	9	0	10	0	12	0
Golf (18 hole)	Course	13	17	4	17	4	20	7	24	11
Tennis courts	Court	133	380	247	388	255	440	307	528	395
Horse trails	Miles	256	503	247	514	258	582	326	693	442
Hiking trails	Miles	76	246	170	251	175	284	208	341	265
Nature trails	Miles	89	1,244	1,155	1,271	1,182	1,440	1,351	1,728	1,639
Bicycle trails	Miles	34	1,745	1,711	1,782	1,748	2,021	1,987	2,424	2,390
Boat docks	Slips	552	6,699	6,147	6,841	6,289	7,755	7,203	9,303	8,751
Boating (water)	Acres	72,700	18,604	0	18,811	0	21,322	0	25,576	0
Water skiing	Acres	72,700	4,144	0	4,234	0	4,798	0	5,755	0

Source: Developed by River Basin Survey Staff, United States Department of Agriculture, using Mississippi SCORP Report Data and adjusted 1972 OBERS population data.

Table 4.39. Demand, supply, and net needs for selected recreation activities, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Recreation Activity	Activity occasions								
	1970			1980		2000		2020	
	Supply	Demand	Net needs	Demand	Net needs	Demand	Net needs	Demand	Net needs
Swimming (pools)	2,079,680	3,326,501	1,246,821	3,397,724	1,318,044	3,851,343	1,771,663	4,619,506	2,539,826
Swimming (beach)	3,858,371	1,790,545	-0-	1,828,902	-0-	2,073,073	-0-	2,486,555	-0-
Play outdoor games	8,433,600	42,161,951	33,728,351	43,064,919	34,631,319	48,814,586	40,380,986	58,550,671	50,117,071
Picnicking	1,361,237	3,948,479	2,587,242	4,033,030	2,671,793	4,571,486	3,210,249	5,483,272	4,122,035
Tent camping	426,334	319,117	-0-	325,955	-0-	369,470	-0-	443,162	16,828
Trailer camping	694,663	408,773	-0-	417,525	-0-	473,275	-0-	567,666	-0-
Group camping	167,916	131,912	-0-	134,739	-0-	152,727	-0-	183,189	-0-
Golf (9 hole)	641,520	169,848	-0-	173,507	-0-	196,668	-0-	235,875	-0-
Golf (18 holes)	429,624	566,186	136,562	578,322	148,693	655,526	225,902	786,268	356,644
Playing tennis	255,360	731,163	475,803	746,822	491,462	846,531	591,171	1,015,372	760,012
Horseback riding	1,075,200	2,111,956	1,036,756	2,157,154	1,081,954	2,445,180	1,369,980	2,932,885	1,857,685
Hiking	35,112	113,447	78,335	115,880	80,768	131,350	96,238	157,545	122,433
Nature walking	28,480	9,956,186	9,927,706	10,169,385	10,140,905	11,527,113	11,498,633	13,826,212	13,797,732
Bicycle riding	489,600	25,133,969	24,644,369	25,672,298	25,182,698	29,099,810	28,610,210	34,903,638	34,414,038
Boating (docks)	145,728	1,768,013	1,622,285	1,805,878	1,660,150	2,046,978	1,901,250	2,455,244	2,309,516
Boating (water area)	6,979,200	1,768,013	-0-	1,805,878	-0-	2,046,978	-0-	2,455,244	-0-
Fresh water skiing	6,979,200	397,854	-0-	406,362	-0-	460,629	-0-	552,505	-0-

Source: Developed by River Basin Survey Staff, United States Department of Agriculture, using Mississippi SCORP Report data and adjusted 1972 OBERS population data.

Table 4.40. Demand, supply, and net needs for acres of land and water area by selected recreation facilities, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Recreation facility	Acres								
	1970			1980		2000		2020	
	Supply	Demand	Net needs	Demand	Net needs	Demand	Net needs	Demand	Net needs
Swimming (pools)	15	24	9	25	10	28	13	33	18
Swimming (beach)	138	64	-0-	66	-0-	74	-0-	89	-0-
Play fields	2,008	10,039	8,031	10,254	8,246	11,623	9,615	13,941	11,933
Picnic sites	460	1,335	875	1,364	904	1,546	1,086	1,855	1,395
Tent camp sites	192	144	-0-	147	-0-	167	-0-	200	8
Trailer camp sites	269	158	-0-	161	-0-	183	-0-	219	-0-
Group camp sites (beds)	163	105	-0-	107	-0-	121	-0-	145	-0-
Golf course (9 holes)	2,640	699	-0-	714	-0-	809	-0-	971	-0-
Golf course (18 holes)	2,080	2,735	655	2,794	714	3,167	1,087	3,798	1,718
Tennis courts	34	95	61	97	63	110	76	132	98
Horse trails	12,800	25,142	12,342	25,680	12,880	29,109	16,309	34,915	22,115
Hiking trails	1,900	6,139	4,239	6,271	4,371	7,108	5,208	8,525	6,625
Nature trails	2,225	31,113	28,888	31,779	29,554	36,022	33,797	43,207	40,982
Bicycle trails	850	43,635	42,785	44,570	43,720	50,521	49,671	60,597	59,747
Boat docks (slips)	167	2,030	1,863	2,073	1,906	2,350	2,183	2,819	2,652
Boating (water area)	72,700	18,604	-0-	18,811	-0-	21,322	-0-	25,576	-0-
Fresh water Skiing (water area)	72,700	4,144	-0-	4,234	-0-	4,798	-0-	5,755	-0-
Gross needs									
Land area		121,427		124,029		140,588		168,627	
Water area		24,778		25,118		28,470		34,150	
Net needs									
Land area			97,885		100,462		116,862		144,639
Water area			1,863		1,906		2,183		2,652

Source: Developed by River Basin Survey Staff, United States Department of Agriculture.

The place of Hernando DeSoto's first view of the Mississippi and the site of his crossing has been widely accepted as the origin of the Sunflower River. No physical evidence has yet been located but the site has been considered for inclusion in the National Register.

Like much of the surrounding area, European explorers and settlers left their marks here and there, but this particular basin is probably best known historically for the part it played in the War Between the States. One of the best known sieges in American history was that of the City of Vicksburg and the battlements are preserved and displayed in Vicksburg National Military Park and Cemetery and the adjacent areas.

Numerous historic sites and parks offer visitors to the basin an opportunity to enjoy outdoor fun and relaxation. The index of historic and archeological sites is shown on pages 4-50 and 4-51. See map 4.1 for the location of these sites.

Fish and Wildlife

The upland area has excellent fish and wildlife resources and has room for expansion of certain fish and game populations. Tables 4.41 and 4.42 show the present and future supplies, demands, and reserves or deficits of fishing and hunting resources. Table 4.41 shows that there is no real problem with adequate fishery resources until the year 2020. These projections are based on supplies of fishing resources remaining the same for future time frames as demand increases proportionally with population increases.

Demand probably will increase proportionally to population increases in future times because the basin will still be rural in nature and fishing will be an important recreation outlet.

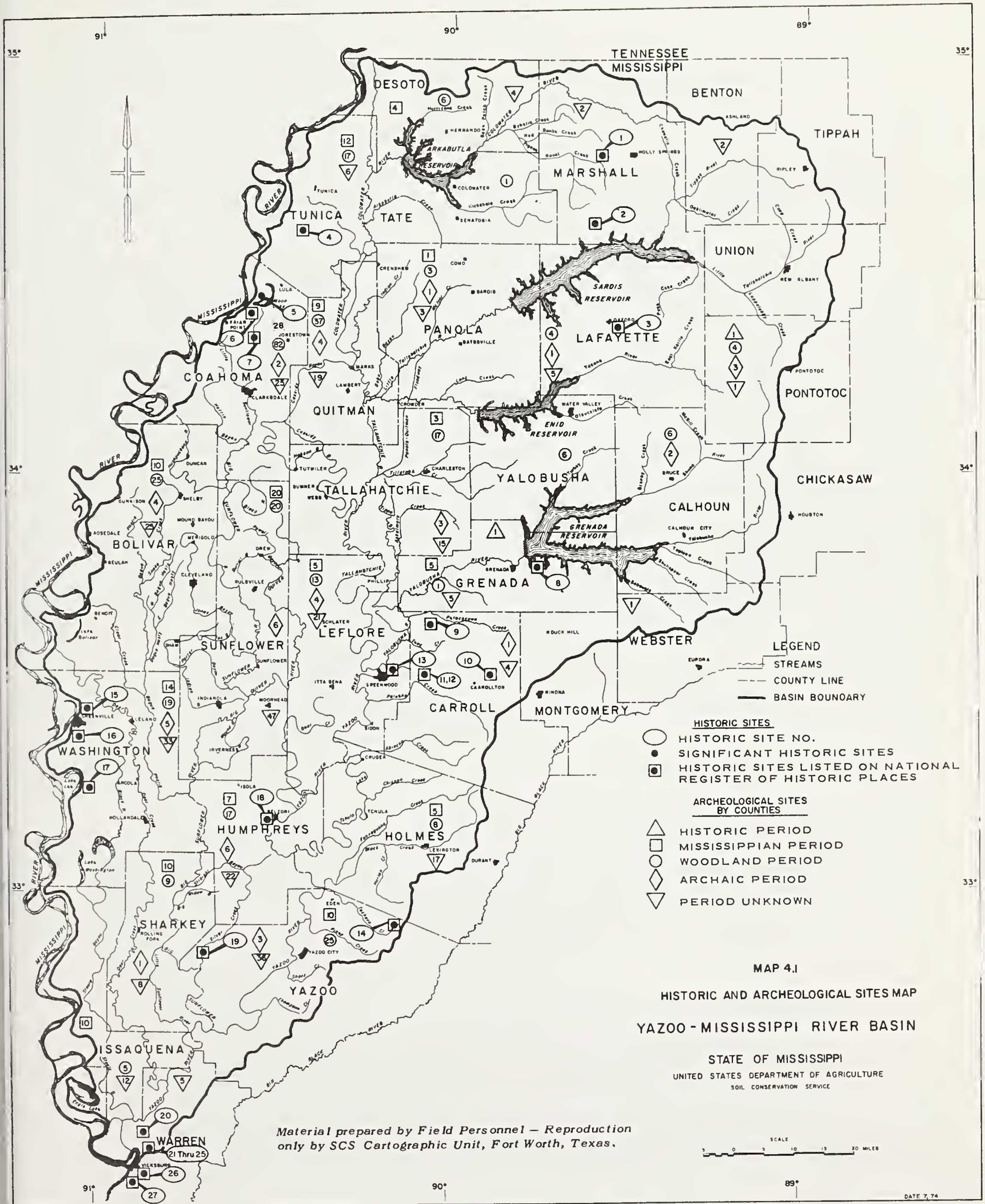
Supplies will probably not remain constant. In all likelihood, there will be a continuing deterioration of general environmental characteristics of the delta which will further deteriorate the fishery resource. Agriculturally-related pollutants (sediment, insecticides, and herbicides) will be the primary cause for further deterioration of delta waters and may cause man day losses of fish resources. There is very little opportunity for development of impounded waters in the delta. The only real opportunity for additional water is by development of completely leveed lakes with wells for a water supply. Such lakes are expensive to build, artificial in appearance, and generally have water management problems associated with shallow impoundment.

Index of Historic and Archeological Sites

Site No.	Name		Description
1	Confederate Armory Site Marshall County, Mississippi	NR	Iron foundry converted to hospital and subsequently burned. Located north of Holly Springs.
2	Civil War Earthworks at Tallahatchie Crossing Marshall County, Mississippi	NR	Federal parapets for a seven-gun battery built in 1862. Located on north bank at Tallahatchie River near Abbeville.
3	Faulkner, William, House Lafayette County, Mississippi	NR	Home of Nobel Prize winner from 1929 to 1963.
4	Hollywood Site Tunica County, Mississippi	NR	Three well-preserved mounds with evidence of daub structures. Located 5 miles southwest of Robinsonville.
5	Sunflower Landing Site Coahoma County, Mississippi		Most likely crossing site by DeSoto in 1541.
6	Yazoo Pass Coahoma County, Mississippi	NR	Site of Civil War attempt to link Mississippi, Coldwater, Tallahatchie, and Yazoo Rivers.
7	Parchman Place Site Coahoma County, Mississippi	NR	Large platform mound with two smaller mounds. Located about 5 miles east of Friars Point.
8	Confederate Earthworks Grenada County, Mississippi	NR	Three Confederate redoubts on south bank of Yalobusha River near Grenada Reservoir.
9	Teoc Creek Archeological Site Carroll County, Mississippi	NR	Outstanding Poverty Point, ca 1250 B.C., site.
10	Malmaison Site Carroll County, Mississippi	NR	Site of impressive two-storied porticoed mansion built in 1854.
11	Merrill's Store Carroll County, Mississippi	NR	Historic store building.
12	George, James Z.; Law Office Carroll County, Mississippi	NR	Office of Senator George (1826-1897).
13	Fort Pemberton Site Leflore County, Mississippi	NR	Site of sinking of "Star of the West" in 1863.
14	Casey Jones Wreck Site Yazoo County, Mississippi	NR	Site of the famous wreck of the Cannonball Express on April 30, 1900, at Vaughn.

Site No.	Name		Description
15	Winterville Site Washington County, Mississippi	NR	Large Mississippian Indian ceremonial site located about 4 miles north of Greenville.
16	Belmont Washington County, Mississippi	NR	One of few remaining antebellum houses in the Mississippi Delta. Located at intersections of Mississippi 1 and 438.
17	Mount Holly Washington County, Mississippi	NR	Two-story brick structure of 30 rooms built in 1855. Located near Foote.
18	Jaketown Site Humphreys County, Mississippi	NR	Eight small low mounds settled shortly after 1000 B.C. Located about 5 miles north of Belzoni.
19	Holly Bluff Archeological Site Yazoo County, Mississippi	NR	Type site for Lake George Period (ca 700-1500 A.D.).
20	Snyder's Bluff Warren County, Mississippi	NR	Site of Fort Saint Peter, built in 1719 by French missionaries. Located near Redwood on the Yazoo River.
21	Vicksburg Siege Cave Warren County, Mississippi	NR	Last remaining Civil War cave used during Vicksburg siege. Located near Vicksburg City Cemetery.
22	Balfour House, Vicksburg Warren County, Mississippi	NR	Home of historian Emma Balfour.
23	Old Courthouse, Vicksburg Warren County, Mississippi	NR	Symbol of Confederate resistance in the Vicksburg campaign.
24	Pemberton House, Vicksburg Warren County, Mississippi	NR	Headquarters of General Pemberton during siege.
25	Planters Hall, Vicksburg Warren County, Mississippi	NR	Historic bank built in 1832.
26	Vicksburg National Military Park Warren County, Mississippi	NR-NP	Site of 47-day siege of Vicksburg in 1863.
27	Chickasaw Bayou Battleground Warren County, Mississippi	NR	Confederate forces defeated General Sherman at the site in 1862.

NR - This site is on the National Register of Historic Places
NP - National Park



MAP 4.1
HISTORIC AND ARCHEOLOGICAL SITES MAP
YAZOO - MISSISSIPPI RIVER BASIN
STATE OF MISSISSIPPI
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LEGEND
STREAMS
COUNTY LINE
BASIN BOUNDARY
HISTORIC SITES
HISTORIC SITE NO.
SIGNIFICANT HISTORIC SITES
HISTORIC SITES LISTED ON NATIONAL REGISTER OF HISTORIC PLACES
ARCHEOLOGICAL SITES BY COUNTIES
HISTORIC PERIOD
MISSISSIPPIAN PERIOD
WOODLAND PERIOD
ARCHAIC PERIOD
PERIOD UNKNOWN
Material prepared by Field Personnel – Reproduction only by SCS Cartographic Unit, Fort Worth, Texas.
SCALE
5 0 5 10 15 20 MILES
DATE 7, 74
TENNESSEE
MISSISSIPPI
DESOTO
BENTON
TIPPAH
MARSHALL
TUNICA
TATE
UNION
PANOLA
LAFAYETTE
COAHOMA
QUITMAN
PONTOTOC
TALLAHATCHIE
YALOBUSHA
CHICKASAW
CALHOUN
BOLIVAR
GRENADA
LEFLORE
SUNFLOWER
WEBSTER
CARROLL
MONTGOMERY
WASHINGTON
HUMPHREYS
HOLMES
SHARKEY
YAZOO
ISSAQUENA
WARREN
ARKABUTLA RESERVOIR
SARDIS RESERVOIR
ENID RESERVOIR
GRENADA RESERVOIR
MISSISSIPPI RIVER
21 Thru 25
35°
34°
33°
91°
90°
89°

Table 4.41. Fishing demand, supply, and needs, Yazoo-Mississippi River Basin, 1970, and projected 1980, 2000 and 2020

Year	Subarea	Population	Fishermen	Demand	Supply	Reserve supply	Additional water needs
		Number	Number	Man days	Man days	Man days	Acres
1970	Delta	326,907	66,506	997,590 1/	1,365,000 3/	367,410	
	Uplands	234,128	81,854	1,637,080 2/	2,123,000 3/	485,920	
	Basin	561,035	148,360	2,634,670	3,488,000	853,330	
1980	Delta	336,666	67,333	1,009,995	1,365,000	355,005	
	Uplands	236,384	82,734	1,654,680	2,123,000	468,320	
	Basin	573,050	150,067	2,664,675	3,488,000	823,325	
2000	Delta	383,741	76,748	1,151,220	1,365,000	213,780	
	Uplands	265,817	93,036	1,860,720	2,123,000	262,280	
	Basin	649,558	169,784	3,011,940	3,488,000	476,060	
2020	Delta	460,278	92,056	1,380,840	1,365,000	-15,840	1,056
	Uplands	318,834	111,592	2,231,840	2,123,000	-108,840	5,442
	Basin	779,112	203,648	3,612,680	3,488,000	-124,680	6,498

Source: Soil Conservation Service, United States Department of Agriculture. (Developed using adjusted 1972 OBERS population data).

1/ Man days demand of delta fishermen is calculated to be 15 man days per year.

2/ Man days demand of upland fishermen is calculated to be 20 man days per year.

3/ See table 4.43.

The uplands have more water acreage than the delta and better quality water (table 4.43). Future time frames should not show a decline in water quality in the uplands equal to the decline in the delta. The demand will probably remain a function of population growth but the supply could increase considerably as there are many impoundment sites in each upland county that can be utilized in future years for additional water storage.

Needs for additional acres of fishing waters are shown in table 4.41. This need could be eliminated if known, accepted, common sense fishery management practices were used on existing waters. Production could be dramatically increased and hence the existing water could supply much more than the present man day capacities per acre per year (table 4.44). The use of slight modifications in requirements for pond construction could also vastly improve the potential productive capacity of a new impoundment. Features such

Table 4.42. Hunting demand, supply, and needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Subarea	Population	Hunters 1/	Demand 2/	Supply	Reserve supply
	Number	Number	Man days	Man days	Man days
Uplands					
1970	234,128	87,825	1,932,150	2,016,056	83,906
1980	236,384	89,826	1,976,172	2,016,056	39,884
2000	265,817	101,010	2,222,220	2,016,056	-206,164
2020	318,834	121,157	2,665,454	2,016,056	-649,398
Delta					
1970	326,907	77,235	1,699,170	1,795,244	96,074
1980	336,666	80,800	1,777,600	1,795,244	17,644
2000	383,741	92,098	2,026,156	1,795,244	-230,912
2020	460,278	110,467	2,430,274	1,795,244	-635,030
Basin					
1970	561,035	165,060	3,631,320	3,811,300	179,980
1980	573,050	170,626	3,753,772	3,811,300	57,528
2000	649,558	193,108	4,248,376	3,811,300	-437,076
2020	779,112	231,624	5,095,728	3,811,300	-1,284,428

Source: Mississippi Game and Fish Commission and Soil Conservation Service, United States Department of Agriculture.

1/ Mississippi game and fish hunter license data, 1972-73.

2/ Includes resident and non-resident hunters at 22-man days per hunter per year.

as bottom flow drains, drawdown structures, and adequate depth to reduce aquatic vegetation problems would improve the capability of ponds for fishery production.

Present Situation - Hunting Resources - Hunting demands, supplies, and reserves or needs are shown in table 4.42. Basinwide, the demand for hunting will outstrip the supply in the year 2000.

Supplies will probably decrease. Further land use changes converting forests to cropland will dramatically affect the delta's capacity to produce game animals. Such land use changes can be expected in the delta and other bottoms in the basin.

Unlike the delta, land use changes in the uplands should have less total effect on the hunting resource. The forests in the uplands can better tolerate encroachment by other land uses and still supply adequate wildlife habitat.

Whereas there is little possibility of any expansion of wildlife populations in the delta, there are areas within the uplands that have adequate habitat for deer and turkey that are presently carrying very few head of these species. Within the next 10 to 15 years these areas should be adequately stocked.

Table 4.43. Existing freshwater habitat and man day fishing capacity, Yazoo-Mississippi River Basin, 1970

Subarea	Small water impoundments 2-40 acres	Streams	Large water impoundments 40 acres	Total
Delta				
Acres	16,000	25,000	50,000	91,000
M.D. capacity	240,000	125,000	1,000,000	1,365,000
Upland				
Acres	53,000	9,000	40,000	102,000
M.D. capacity	1,060,000	63,000	1,000,000	2,123,000
Basin				
Acres	103,000	1/ Added to	90,000	193,000
M.D. capacity	1,488,000	small water	2,000,000	3,488,000

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Basin total for streams is considered as small water.

Table 4.44. Man day fishing capacities per acre per year, Yazoo-Mississippi River Basin, 1970

Type of water	Upland	Delta
Small impoundments	20 man days	15 man days
Large impoundments	25 man days	20 man days
Streams	7 man days	5 man days

Source: All values set by joint agreement between Soil Conservation Service Biologist and Mississippi Game and Fish Commission Biologist.

Waterfowl populations are extremely high in the delta during the winter months. Further development of this resource could easily occur on private farmlands as well as public areas. Low lying soybean fields and woodlands can easily be developed to hold water during winter months. Obviously this potential is not as prevalent in the uplands.

Needs - Hunting Resource - Tables 3.12 and 4.42 show that hunting is an extremely valuable resource that is steadily declining insofar as supply is concerned. At present rates of demand and assuming the 1970 supply to remain constant, a negative supply pattern will develop before the year 2000. The preservation of existing bottomland hardwoods, wetlands, mixed pine hardwood upland forest, and small game habitat in farmland areas is the real need for the basin to meet future hunting demands. Improved wildlife management practices by private landowners and public land managers can help forestall a negative supply by producing more game per acre of habitat, but the eventual outcome will be a diminishing resource unless habitat loss is controlled.

Agricultural Pollutants

The primary agricultural pollution problems in the Yazoo-Mississippi River Basin are: (1) insecticides, (2) plant nutrients, (3) animal waste, and (4) sediment. The magnitude of sediment pollution problems was presented previously.

The magnitude of each of the remaining three pollution problems (insecticides, plant nutrients, and animal waste) vary considerably within the basin, and depends upon numerous factors including land use, terrain, and soil types. The most significant pollution problem is probably from insecticides. The intensive use of insecticides, particularly in the delta, has created a definite impact upon the environment, both beneficial and detrimental.

For clarity and supportive data, each pollution problem is presented separately.

Insecticides - The use of insecticides on cotton consumes a large majority of the insecticides used within the basin. The use of insecticides on soybeans requires a very small amount and often most of the soybean acreage does not require any insecticides. Therefore, to project insecticide usage in the basin, the cotton acreage was used as the projection media.

The use of insecticides in the basin depends not only upon cotton acreage but also insect infestation. This is reflected by data for the State of Mississippi that shows the amount of insecticides sold to farms or farm suppliers (table 4.45).

Table 4.45. Acres of cotton harvested and sale of insecticides, State of Mississippi, 1969-1973

Item	1969	1970	1971	1972	1973
Cotton in Miss. (Ac.)	1,225,000	1,235,000	1,355,000	1,644,000	1,370,000
Total insecticide sold in Miss. to farms or farm suppliers (lbs)	14,052,484	17,352,500	26,734,000	38,000,615	16,376,950
Lbs. of insecticide applied per acre	11.47	14.05	19.73	22.84	11.95

Source: Statistical Reporting Service, United States Department of Agriculture and Mississippi Extension Service, Mississippi State University.

As illustrated in table 4.45, the usage of insecticides fluctuate considerably, depending upon insect infestation and acreage planted. For projection purposes, the geometric mean of the application rates (15.41 lbs./ac.) was used. Present and projected insecticide use is shown in table 4.46.

The geometric mean of the application rate may vary in future years due to the toxicity of the future insecticides. Based on sales data for the past five years, it is assumed that approximately 97 percent of the insecticides will be Methyl Parathion and Toxaphene. Of the two insecticides, Methyl Parathion is assumed to account for 35 percent of the total usage and Toxaphene 62 percent.

The intensive use of insecticides has definitely created environmental problems along with the benefits of increased crop production. The major problems are (1) disposal of containers; (2) increased levels of insecticides in man, fish, and wildlife; and (3) increased levels of insecticides in the basic resources - air, land, and water.

The insecticide containers have been increasing in volume consistently. It is estimated that over 420 thousand containers were used in 1969 and over 710 thousand containers in 1973. The container size varied from one-half gallon can to the 55-gallon drum.

Table 4.46. Acreage of cotton harvested and insecticide application, Yazoo-Mississippi River Basin, 1970, and projected 1980 and 2020

Item	Unit	1970	1980	2020
Cotton harvested	Acres 1/	831,000	573,300	602,200
Application rate	Lbs./ac.	15.41	15.41	15.41
Insecticide quantity	Pounds	12,805,710	8,834,553	9,279,902

Source: Acreage data from Economic Research Service, United States Department of Agriculture. Insecticide use based on rates from Mississippi Extension Service.

1/ With development acreage.

Two suppliers of insecticides have begun to ship the material to aerial applicators in bulk and store the insecticides in stainless steel or fiberglass tanks that are reusable. Hopefully, this marketing technique will continue and reduce the occurrence of haphazardly discarding or misusing the container.

The occurrence and magnitude of insecticide in fish and wildlife has generally been increasing. Studies conducted by the Mississippi Game and Fish Commission have verified the continued increase in DDT plus metabolites and Toxaphene in fish and wildlife. Since DDT has been banned, the concentration of DDT and metabolites should begin to decrease, but the use of Toxaphene and other chlorinated hydrocarbon insecticides may increase, consequently creating increased amounts in fish and wildlife as shown in table 4.47.

Similar studies by the Biochemistry Department of Mississippi State University have been conducted on wildlife and man. The results are summarized in tables 4.48 and 4.49.

The insecticide residues in man may be from a combination of direct contact with insecticides and indirect exposure from contaminated basic resources. All of the basic resources have reflected concentrations of insecticides which are summarized in tables 4.50, 4.51, and 4.52.

As reflected in the above data, the intensive use of insecticides has exerted a definite impact upon the environment. Residues of the insecticides are present in the three basic resources (land, air, and water) and in the related resources (man, fish, and wildlife).

Table 4.47. Concentration of DDT plus metabolites and Toxaphene in fish, Yazoo-Mississippi River Basin, 1969-1973

Insecticide	Range of concentration in fish flesh	Median level	Fish samples with positive measurable quantities
	ppm	ppm	Percent
		- 1969 study -	
DDT plus metabolites	0.15 to 10.60	1.78	100
Toxaphene	0.0 to 20.0	1.05	5
		- 1972 thru 1973 study -	
DDT plus metabolites	0.05 to 9.15	3.26	100
Toxaphene	0.0 to 33.34	8.88	60

Source: Mississippi Game and Fish Commission.

Table 4.48. Insecticides in deer fat, Yazoo-Mississippi River Basin, 1969-1970

Item	DDT plus metabolites	Dieldrin
	ppm	ppm
Range	0.389 to 14.476	0 to 0.039
Average value	2.93	0.009

Source: Biochemistry Department, Mississippi State University.

Table 4.49. Total concentration of DDT in human blood samples, State of Mississippi, 1971-1973

Race and sex	High (Delta region) 1/ 1971 to 1972	High (Delta region) 1/ 1972 to 1973	Medium (East Central) 1971 to 1972	Medium (East Central) 1972 to 1973	Low (Southern & Coastal) 1971 to 1972	Low (Southern & Coastal) 1972 to 1973
	Concentration in ppb					
White, male	60	57	43	35	40	33
Non-white, male	153	112	100	74	62	55
White, female	41	46	32	30	30	34
Non-white, female	65	100	-	-	14	64

Source: Biochemistry Department, Mississippi State University.
1/ Entirely within the basin.

Table 4.50. Insecticide levels in air samples, selected locations, Yazoo-Mississippi River Basin, 1970-1973

Location	Time of study	Insecticide	Range of concentration
			ng/cu.m
Scott, Miss.	July 1, 1972 to July 1, 1973	Toxaphene	24 to 3,500
		Total DDT	17 to 1,100
		Methyl Parathion	0 to 370
Stoneville, Miss.	March 1970 to October, 1973	Toxaphene	0 to 3,100
		Total DDT	0 to 1,100
		Methyl Parathion	0 to 500

Source: Biochemistry Department, Mississippi State University.

Table 4.51. Insecticide levels in soil samples, Yazoo-Mississippi River Basin, 1967-1969

Insecticide	Range of residues	Average
	ppm	ppm
Total DDT	0.45 to 35.10	3.61
Toxaphene	0 to 110.30	8.88
Dieldrin	0 to 0.49	0.07
Endrin	0 to 5.90	0.40

Source: Biochemistry Department, Mississippi State University.

Table 4.52. Insecticide levels in water resources, Yazoo- Mississippi River Basin, 1970-1972

Insecticide	Range
	ppb
- - Surface Water 1/- -	
Total DDT	Trace to 0.804
Toxaphene	0 to trace
- - Ground Water 2/ - -	
Total DDT	0.004 to 0.012
Aldrin	0 to 0.019
Dieldrin	0 to 0.001
Toxaphene	0

Source: Biochemistry Department, Mississippi State University.
1/ 1970 to 1971.
2/ 1972.

Plant Nutrients - Eutrophication, the abundant growth of aquatic weeds due to overfertilization of surface waters, has often been considered a major water quality problem in many areas of the United States. The aquatic vegetation, similar to land vegetation, requires a certain amount of various nutrients for survival and an abundance of the nutrients will create an abundance of growth. But, if one of the necessary elements are limited, the growth of the vegetation will be limited.

It has been suggested that nitrogen and phosphorus may be the elements that can be limited by man and thus limit aquatic vegetation growth. Studies have indicated that some species of aquatic vegetation can obtain sufficient nitrogen from the atmosphere for abundant growth; therefore, recent emphasis has been placed on controlling phosphorus. Nitrogen is still a concern for underground water supply due to health reasons. Thus, nitrogen with levels above 10 mg/l as N, in the form of nitrate (NO_3), may cause oxygen depletion problems in infants. Commercial fertilizers have been considered a source of nitrates in surface waters and in underground water supplies; therefore, fertilizer is considered in this study.

The available statistics on fertilizer use does not lend itself to projecting the actual quantity used in the basin due to the highly variable fertilizer application rates. The best available approach was to develop an estimate from Extension Service specialists who were familiar with the application rates used for various agricultural purposes in the basin. These estimated application rates were converted to the basic elements and applied to the various agricultural land uses for developing the total quantity of plant nutrients consumed. Table 4.53 illustrates the total quantity consumed in 1973.

Nitrogen - When nitrogen is applied to crops, the movement of commercial fertilizer nitrogen and the nitrogen that is present in the soil is very complex. The applied nitrogen is usually in the ammonia form, and with microbial activity in the soil, the nitrogen is converted from ammonia to nitrite to nitrate. During this conversion process, some of the nitrogen is removed by the plants. Nitrate is water soluble and will tend to leach from the upper soil profiles, but if the nitrate enters an anaerobic zone created by a restriction in the soil and the micro-organisms are present, the nitrate may be converted from nitrate to nitrite to gaseous nitrogen. Another interesting facet of nitrogen is that at least 90 percent of the natural nitrogen in soil is in organic forms which are highly resistant to microbial action and thus immobile. Some of the applied fertilizer nitrogen also becomes fixed in the soil which has been illustrated in greenhouse experiments to amount to 20 percent to 40 percent immobilization.

The actual amount of nitrogen that leaches from the soil is unknown, but with the cropping systems used in the basin, very little nitrogen should be leaving the fields in surface or subsurface water flow. This is further verified from an analysis by the Mississippi State Board of Health on subsurface water supplies. The nitrogen analysis of subsurface water has consistently been at or near zero. Also, the sparse water sampling of surface streams may indicate a general reduction of the mobile forms of nitrogen

Table 4.53. Estimates of fertilizer use, Yazoo-Mississippi River Basin, 1973

Crops	Acres	Nitrogen		Phosphrous		Potassium	
		Lbs/acre	Total	Lbs/acre	Total	Lbs/acre	Total
Corn	39,000	140	5,460,000	8.7	339,300	16.6	647,400
Wheat	125,400	87	10,909,800	8.7	1,091,000	16.6	2,081,600
Soybeans	1,602,800	3	4,808,400	5.8	9,296,200	10.1	16,188,300
Cotton	831,000	93	77,283,000	11.6	9,639,600	22.1	18,365,100
Pasture							
Permanent	943,000	24	22,632,000	2.62	2,470,700	2.62	2,470,700
Temporary	326,000	100	32,600,000	10.92	3,559,900	4.98	1,623,500
Total	XXX	XXX	153,693,200	XXX	26,396,700	XXX	41,376,600

Source: Soil Conservation Service, United States Department of Agriculture and Mississippi Extension Service.

(nitrate and nitrite) although organic nitrogen is increasing, which may be due to waste loads from towns and industry (table 4.54).

The actual rate of nitrogen leaching or movement into surface waters is unknown, but from the available data, the movement of nitrogen appears to be minimal and the concentration reducing in surface water. The level of nitrogen in the subsurface water supply is at or near zero.

Table 4.54. Summary of nitrogen in surface streams, Yazoo-Mississippi River Basin, 1966-1972

Nitrogen phase and water year	No. of positive samples	No. of negative samples	Range of positive samples (N)	Avg. value of N for positive & negative samples (N)
			mg/1	mg/1
1971-1972				
Organic nitrogen	-	-	-	-
Nitrite	-	-	-	-
Nitrate	11	7	0.02 to 0.47	0.12
1970-1971				
Organic nitrogen	3	0	1.2 to 1.6	1.4
Nitrite	3	0	0.003 to 0.012	0.006
Nitrate	6	0	0.045 to 0.38	0.18
1969-1970				
Organic nitrogen	15	0	0.56 to 1.8	1.06
Nitrite	12	2	0.02 to 1.2	0.34
Nitrate	-	-	-	-
1966-1967				
Organic nitrogen	-	-	-	-
Nitrite	-	-	-	-
Nitrate	10	0	0.02 to 1.26	0.35

Source: Water Resource Data for Mississippi, Geological Survey, United States Department of the Interior.

Phosphorus - The movement of phosphorus, whether applied as fertilizer or present in the soil, is usually very restricted. Phosphorus is usually bound to the soil's clay fraction; thus, the movement of phosphorus is dependent upon the movement of the clay soil particles. Of the phosphates absorbed on soil colloids, only a fraction will be available for aquatic plant growth, and this fraction has often been estimated at no more than 10 percent.

Experiments with cotton and corn in Virginia showed a loss of five tons per acre of soil containing 1000 ppm of phosphorus, which represents a loss of 10 pounds of phosphorus per acre. Applying a high estimate of 10 percent (ortho-phosphorus) available for aquatic growth, one pound per acre would be available for aquatic plant growth. The actual amount of phosphorus lost from the agricultural sector in the basin is unknown. The only indication of the phosphorus content in streams is from USGS reports for 1970 and 1971 and the results are shown in table 4.55.

The number of samples are too few to develop any indication of the trends in the levels of phosphorus in streams. Also, the source of phosphorus is unknown; therefore, making projections impossible.

It is often stated that 0.01 ppm is the maximum quantity of phosphorus allowable in lakes to control blue-green algae and concentrations of 0.05 ppm provide for spontaneous algae growth. Applying these values, one may assume that some of the lakes in the basin may have a spontaneous growth of algae if the inflow of water into lakes is similar to that of streams analyzed by USGS.

Table 4.55. Presence of ortho-phosphorus in streams, Yazoo-Mississippi River Basin, 1970-1971

Water year	Number of samples	Range of ortho-phosphorus	Average values
		ppm	ppm
1970	14	0.04 to 0.16	0.09
1971	6	0.02 to 0.15	0.08

Source: Water Resource Data for Mississippi, Geological Survey, United States Department of the Interior.

It may be concluded that to control phosphorus from agricultural land requires the control or reduction of erosion. The actual amount of commercial fertilizer that leaves the land and enters the stream is unknown, but the quantity is thought to be low. The upland soils are generally considered relatively poor in phosphorus, but the delta soils have a fairly high level of phosphorus. Therefore, the level of phosphorus in streams may be from erosion of cropland, natural erosion, municipal and industrial waste, or animal waste.

Animal Waste - The pollution potential from animal waste is considered to be proportionate to the degree of confinement and waste management at confinement systems. Animals with free access to large open spaces such as pastures are not considered to be creating a pollution problem since the waste material would be sparsely scattered over the terrain and not concentrated.

In the basin, most of the beef and dairy cattle are allowed free access to pastureland although the dairy animal will be confined during milking and pollution potential must be considered. The entire swine and poultry populations are considered to be totally confined. The pollution potential from each animal group is portrayed in table 4.56.

The amount of waste that streams received from animals was based upon the degree of confinement and the waste management techniques used with confinement systems, which governed the rate of pollution as determined by a study conducted at North Carolina State University at Raleigh.1/ The subsequent population equivalent that was developed provides a point of reference which may be applied to other waste sources within the river basin. It should be recognized that the total population equivalent is not applied to a specific point but at numerous points within the river basin.

The concepts used in animal waste treatment are (1) treat the waste material to control water pollution only, and (2) treat the waste material to control both water and air pollution. Controlling only water pollution would allow anaerobic decomposition treatment components. Controlling both water and air pollution requires aerobic treatment components, additional use of water, and more energy consumption.

1/ Role of Animal Wastes in Agricultural Land Runoff, Water Pollution Control Research Series, EPA Grant No. 13020 DGX, by Department of Biological and Agricultural Engineering, School of Agriculture and Live Sciences, North Carolina State University at Raleigh, dated August 1971.

Table 4.56. Summary of pollution potential from livestock and poultry, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Year	Item	Beef 1/	Dairy cows	Swine	Poultry	
					Broiler	Layers
1970	Total population	695,300	46,100	181,600	5,959,500	2,091,900
	Confinement population	6,000	1,000 2/	181,600	5,959,500	2,091,900
	Waste load (BOD_5) lbs/yr	154,800	3.81×10^6	4.84×10^6	-	1.37×10^6
	Population equivalent	1,600	58,000	74,000	-	21,000
1980	Total population	885,534	42,338	270,242	8,269,874	2,298,161
	Confinement population	7,642	918 2/	270,242	8,269,874	2,298,161
	Waste load (BOD_5) lbs/yr	197,164	3.5×10^6	7.20×10^6	-	1.5×10^6
	Population equivalent	1,900	50,000	104,000	-	22,000
2000	Total population	1,009,202	52,254	270,093	11,547,108	2,941,839
	Confinement population	8,709	1,133 2/	270,093	11,547,108	2,941,839
	Waste load (BOD_5) lbs/yr	224,460	4.3×10^6	7.20×10^6	-	1.9×10^6
	Population equivalent	2,100	58,000	99,000	-	26,000
2020	Total population	1,600,855	63,816	351,396	15,502,678	3,726,511
	Confinement population	13,814	1,384 2/	351,396	15,502,678	3,726,511
	Waste load (BOD_5) lbs/yr	356,401	5.27×10^6	9.36×10^6	-	2.4×10^6
	Population equivalent	3,200	72,000	128,000	-	32,000

	Year			
	1970	1980	2000	2020
Total population equivalent 3/	154,600	178,000	185,000	235,000

Source: Economic Research Service and Soil Conservation Service, United States Department of Agriculture.

1/ COD applied instead of BOD_5. Eighty percent of the cattle are confined on slotted floors with waste recycled to land and not considered a pollution problem.

2/ Number of totally confined animals, remainder confined for milking.

3/ Population equivalent is calculated by dividing the total pounds of BOD_5 by the average projected waste load of 1 man which is 0.18 pounds BOD_5/day in 1980, 0.19 pounds BOD_5/day in 1990, and 0.20 pounds BOD_5/day in 2000 and 2020.

The waste treatment concept for controlling water pollution is pretreatment, storage, and irrigation. The treatment components consist of an anaerobic lagoon for pretreatment, solids settling, and sludge storage; a facultative lagoon for storage of waste water during inclement weather (normally six months' storage); and an irrigation system for the final disposal of the accumulated waste water. Some confinement units may have storage methods available and require only the cost of purchasing and the expense of operating a liquid manure spreader. The estimated cost of controlling water pollution from the animal population is summarized in table 4.57.

The waste treatment concept for abating air and water pollution is pretreatment, storage and irrigation with all components functioning in an aerobic condition. The waste treatment components are an aerated lagoon, an aerated storage reservoir, and an irrigation system. The air abatement approach added to the abatement of water pollution nullifies the use of odor-producing waste treatment systems. In addition, air abatement requires extra water to be used for frequent removal of the waste from the confines of the animal. Also, in some confinement units, alterations to the confinement building would be required. The costs for abating air and water pollution are summarized in table 4.58.

Table 4.57. Estimated annual cost for controlling water pollution from confined animals, Yazoo-Mississippi River Basin, 1970

Type of livestock	Annual cost	Cost per head
	Dollars	Dollars
Beef	2,900 1/	2.42
Dairy	600,000	13.02
Swine	651,000 2/	3.58
	881,000 3/	4.85
Poultry	214,000 4/	0.10
Total	1,467,900 2/	
	1,697,900 3/	N/A

Source: Soil Conservation Service, United States Department of Agriculture.

1/ For 1200 head on solid concrete floors.

2/ Cost for confined swine but not for brood sows on dry lots.

3/ Cost for confined swine and brood sows on dry lots.

4/ Cost for layer operation. Broilers are not considered creating water pollution problem due to the presently used waste management systems.

Table 4.58. Estimated annual cost for controlling air and water pollution from confined animals, Yazoo-Mississippi River Basin, 1970

Animal	Annual Cost	Cost per head
	Dollars	Dollars
Beef	Unknown	--
Dairy	1,564,000	34.00
Swine	1,972,000	10.86
Poultry	1,777,000	0.85
Total	5,313,000	N/A

Source: Soil Conservation Service, United States Department of Agriculture.

As illustrated in tables 4.57 and 4.58, the average annual cost for abating air pollution as well as water pollution increases the cost by a factor of 3.13. If funds are not available in the form of grants, the cost for controlling both air and water pollution would eliminate the profit from some confined animal operations.

Industrial Waste Production

Heavy metals such as arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc are used in a variety of manufacturing processes and products. For example arsenic is used in glassware and ceramics, in tanneries, in dye manufacture, in chemical industries, in compounds for therapy, and as a wood preservative and pesticide. Mercury is being replaced with other substances, but it is used in power generation, in the manufacture of lamps, in medical products, disinfectants, pigments, and as a catalyst.

Nutrients, such as nitrite, nitrate, and phosphorus are used in meat packing and in the manufacture of fertilizers, and in oil refineries.

Toxics include ammonia, cyanides, and pesticides. Ammonia is associated with meat, poultry, and fish industries. Rinsing of fruits and vegetables in preparation for canning often gives rise to wastewaters containing pesticides. Chemical industries and fertilizer manufacturing plants can also be sources of toxic materials.

Most all industries produce wastewater that cause odors. Meat, poultry, and fish rendering plants, and paper mills present particularly difficult problems.

Color is caused by suspended solids or substances in solution. Of particular importance as sources are paper mills, meat and fish processing, and vegetable canning plants. Certain chemical industries generate wastewaters high in color concentrations.

Oil and grease are often found in the wastewaters of industries because of their use in lubrication of machinery. Oil refineries and cooking oil refineries (cotton seed, soybean, and fish oil) and some chemical industries are potential large sources of oil and grease.

In 1970 there were 84 industries classified as producing biodegradable waste in the basin. Major categories involved in this waste production were Food and Kindered Products (73 percent of the total number of industries in the basin), Chemical and Allied Products (20 percent), Paper and Allied Products (4 percent), Petroleum and Coal Products (2 percent), and Rubber and Plastic Products (1 percent).

Industrial organic waste production is comparatively small in the basin. The 84 industries inventoried are located in or near 27 communities with Vicksburg, Yazoo City, and Greenville being the largest centers. In 1970 the combined municipal (domestic and commercial) and industrial loads discharged to the Mississippi River from Vicksburg and Greenville were 30,779 and 4,102 pounds of BOD_5 per day respectively. The load discharged to the Yazoo River from Yazoo City was 5,302 pounds of BOD_5 per day. Paper, food processing, chemicals, and rubber and plastics industries produce the largest quantities of organic wastes in the Vicksburg area. Paper, chemicals, and petroleum and coal industries produce organic waste in the Yazoo City area. In the Greenville area food processing and chemical industries are the main industries that produce organic wastes.

As shown in table 4.59, the population equivalent for 1970 will increase from 517,600 to 1,909,800 by the year 2020. This is an increase of 269 percent.

Average industrial organic waste treatment is estimated at 55 percent BOD_5 removed throughout the basin. Total industrial BOD_5 removed by existing treatment in 1970 was 51,240 pounds per day. Projected industrial organic pollution control needs are presented in table 4.60.

Table 4.59. Industrial organic waste production, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Load category	Daily organic waste production			
	1970	1980	2000	2020
P.E. 1/	517,600	588,400	968,900	1,909,800
#BOD 2/	93,160	111,790	193,780	381,960

Source: Water Quality and Pollution, Appendix L, Lower Mississippi Region Comprehensive Study.

1/ P.E. - Population equivalents.

2/ #BOD - Pounds of 5-day biochemical oxygen demand.

Table 4.60. Industrial organic pollution control needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Load category	1970	1980	2000	2020
	Pounds of BOD_5 per day			
Total	93,160	111,790	193,780	381,960
Exstg. trmt.	51,240	51,240	51,240	51,240
Net need	41,920	60,550	142,540	330,720

Source: Water Quality and Pollution, Appendix L, Lower Mississippi Region Comprehensive Study.

Municipal Waste Production

The basin has 43 sewered communities of 1,000 or more inhabitants. The total population served in 1970 was estimated at 258,200. The total raw waste production was 46,480 pounds of BOD.1/ According to projected population, the sewered population is expected to be 483,400 in 2020 which is an increase of 87 percent. Correspondingly, the total raw BOD waste production will increase to 96,680 pounds per day by 2020 (table 4.61).

Of the 43 sewered communities with 1,000 or more inhabitants, there are 30 (70 percent of the basin total) that have less than 5,000 inhabitants. The total sewered population of these smaller communities is 64,700 or 25 percent of the total for the basin.

1/ Wastes, other than bacteria, which can be removed from water in the process of decomposition by aerobic bacteria. These wastes are measured and expressed in terms of 5-day BOD (BOD_5) or the number of pounds of oxygen required for the first 5 days of their decomposition.

Table 4.61. Municipal organic waste production, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Load category	Daily raw organic waste production			
	1970	1980	2000	2020
P.E. 1/	258,200	279,400	352,600	483,400
#BOD 2/	46,480	53,090	70,520	96,680

Source: Water Quality and Pollution, Appendix L, Lower Mississippi Region Comprehensive Study.

1/ P.E. - Population equivalent.

2/ #BOD - Pounds of 5-day biochemical oxygen demand.

Their average raw waste production is 388 pounds of BOD_5 per day. Six communities, or 14 percent, are in the range of 5,000 to 9,900 inhabitants and have a total sewered population of 46,400 or 18 percent of the basin total. The average raw waste production is 1,392 pounds of BOD_5 per day. Seven communities, or 16 percent, are in the range of 10,000 to 49,900 inhabitants and comprise a sewered population of 147,100 or 57 percent of the total for the basin. Their average raw waste production is 3,783 pounds of BOD_5 per day.

Many of the sewered communities discharge their effluent to small streams that seasonally have little or no flow. As a consequence, even secondary treatment of sewage may be inadequate and local water quality problems may arise. Data for municipal organic pollution control needs are presented in table 4.62.

Municipal waste treatment levels vary widely between communities. Average municipal sewage treatment for communities in the basin are estimated at 50 percent in the State of Mississippi. Total municipal BOD_5 removed by existing treatment in 1970 was about 23.2 thousand pounds per day (see table 4.62).

Health Aspects

General - The presentation of material deviates from the established format for the basin. The nature of health aspects is predicated on activities of Mississippi health agencies. Presentation on a state basis was determined to best fit the needs of the report. In addition, the needs developed are primarily qualitative and do not necessarily lead to quantitative measurement.

Table 4.62. Municipal organic pollution control needs, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Load category	1970	1980	2000	2020
	- - - - - - -	-Pounds of BOD_5	per day - - -	- - - - - - -
Total	46,480	53,090	70,520	96,680
Exstg. trmt.	23,240	23,240	23,240	23,240
Net need	23,240	29,850	47,280	73,440

Source: Water Quality and Pollution, Appendix L, Lower Mississippi Region Comprehensive Study.

Present Status - Historically, diseases associated with water or transmitted by vectors have been important in Mississippi. Data assembled from CDC Reports,1/ 1960-1970, are presented in table 4.63. The table allows a comparison of five potential waterborne diseases occurring in the Mississippi portion of the region with the same waterborne diseases occurring nationwide. The comparison reveals a higher incidence of typhoid fever in Mississippi and a lower incidence of the other four diseases. In addition, a check of specific waterborne disease outbreaks which directly implicated drinking water as a source of disease transmission showed that none were documented to have occurred in the Mississippi portion of the region.

Drinking water in the basin is supplied entirely from ground water. The bacteriological and chemical quality of the ground water in Mississippi is generally acceptable for drinking water systems with disinfection. Ground water data compiled by the U. S. Geological Survey indicated the general occurrence of iron and hardness as chemical constituents which require additional treatment. Although these constituents are not of major health significance, they are very important to the consumer acceptance of drinking water.

Health surveillance of water supplies in Mississippi is provided by the Division of Sanitary Engineering, Mississippi State Board of Health. The state program operates on an annual budget of $100,000. Thus, Mississippi spends approximately 4.5 cents per capita for health surveillance of drinking water. The water supply program operates out of Jackson with a professional staff of six. The absence of essential program elements such as statutory authority, drinking water quality criteria, and water system operator certification, has led to a generally poor status of water systems in Mississippi.

1/ Center for Disease Control, Atlanta, Georgia.

Table 4.63. Incidence of potential waterborne disease, Mississippi, 1960-1970

Year	Amebi-asis	Hepa-titis1/	Salmon-ellosis	Shigel-losis	Typhoid
1960					
Reported Miss 2/ Cases	7	237	23	23	3
Reported US Cases	3,424	41,666	6,929	12,487	816
Percent	0.20	0.56	0.33	0.18	0.36
1961					
Reported Miss Cases	23	655	11	25	4
Reported US Cases	2,850	72,651	8,542	12,571	814
Percent	0.80	0.90	0.12	0.20	0.50
1962					
Reported Miss Cases	20	377	14	28	3
Reported US Cases	3,048	53,016	9,680	12,443	608
Percent	0.65	0.71	0.14	0.22	0.50
1963					
Reported Miss Cases	8	245	16	32	9
Reported US Cases	2,886	42,974	15,390	13,009	556
Percent	0.27	0.57	0.10	0.24	1.6
1964					
Reported Miss Cases	6	115	25	34	3
Reported US Cases	3,304	37,740	17,144	12,984	501
Percent	0.18	0.30	0.14	0.26	0.60
1965					
Reported Miss Cases	1	127	16	32	4
Reported US Cases	2,768	33,856	17,161	11,027	454
Percent	0.03	0.32	0.09	0.30	0.88
1966					
Reported Miss Cases	4	138	22	41	3
Reported US Cases	2,921	32,859	16,841	11,888	378
Percent	0.13	0.41	.13	.34	.79
1967					
Reported Miss Cases	7	207	3	38	7
Reported US Cases	1,157	38,909	18,120	13,474	396
Percent	0.60	0.53	0.01	.28	1.7
1968					
Reported Miss Cases	2	196	24	33	6
Reported US Cases	3,005	45,893	16,514	12,180	395
Percent	0.06	0.42	.14	.27	1.5
1969					
Reported Miss Cases	3	178	38	23	6
Reported US Cases	2,950	48,416	18,419	11,946	364
Percent	0.10	.36	.20	.19	1.6
1970					
Reported Miss Cases	10	104	55	34	1
Reported US Cases	2,888	56,797	22,096	13,845	346
Percent	0.34	.18	.24	.24	.28
Totals					
Reported Miss Cases	91	2,579	247	343	49
Reported US Cases	31,201	504,777	166,836	137,854	5,628
Percent	.28	.51	.148	.248	.87

Source: Morbidity and Mortality Reports, Center for Disease Control, Atlanta, Georgia.

1/ Includes serum hepatitis for years 1960-1965.

2/ Mississippi data is a part of the State's total, calculated as follows: $\frac{\text{Population of Miss in LMR}}{\text{Population of LMR}} \times$ Total Miss Cases of Specific Disease

Hurricane Camille struck Mississippi in 1969 and caused widespread contamination of public water supplies in an area outside the region. Post-emergency restoration was severely hampered by pre-emergency water system deficiencies. This experience convinced the state to endorse chlorination of all public water supplies.

The state is gradually improving their health surveillance program but the number of water systems in Mississippi, particularly the federally-supported rural water districts, are growing at a faster pace. Consequently the health protection for water supplies is being diluted even further.

Mississippi has some major water-based recreation areas. Arkabutla, Sardis, Enid, and Grenada Reservoirs offer a great deal in the way of a healthy environment for the primary contact recreationist.

The responsibility for health protection of the recreationist is vested in the state health agency. However, the state health agency does not have a comprehensive program to provide the field surveillance and water quality monitoring necessary to implement this responsibility.

State Water Quality Standards for Mississippi have established bacteriological criteria for primary contact recreation waters as not to exceed a log mean of 200 fecal coliform per 100 m/l. Little is known about water quality of primary contact recreation waters in Mississippi. However, experience in many areas of the South has indicated that bacteriological quality of streams and small lakes and ponds is quite variable and may exceed established standards. The warm climate and relatively flat topography of Mississippi support high bacteriological levels. Studies have also shown that impoundments can improve the bacteriological quality of impounded waters. The trend of reduction in both total and fecal coliform levels from reservoir inlet to reservoir outlet should be applicable. A large reservoir would be expected to affect a greater reduction with greater retention time and travel distance, provided no pollution enters the reservoir directly.

Enabling legislation in Mississippi for the creation and operation of mosquito abatement districts, applicable only to the coastal counties, will not permit the formation of districts within the region. Inasmuch as enabling legislation merely permits a local area to vote for or against the formation of a vector abatement district, and to provide for local financing, the reasons for including restrictive phrasing in the act are difficult to understand.

Fifty-three species of mosquitoes in nine genera have been recorded for the state with the rice field mosquitoes, Psorophora confinnis and Psorophora discolor; the malaria mosquito, Anopheles quadrimaculatus; the southern house mosquito, Culex P. quinquefasciatus; and the yellow fever mosquito, Aedes aegypti, of greatest importance within the Mississippi delta.

The second rise on the Mississippi River usually subsides in June. At this time, there are ordinarily produced many mosquitoes, mostly in the genera Culex and Psorophora. All delta communities have an abundance of the southern house mosquito, Culex P. quinquefasciatus, which is a major vector of urban St. Louis encephalitis.

The yellow fever mosquito, Ae. aegypti, has remained relatively abundant in Vicksburg, and has recently become re-established in Natchez following several years of unexplained absence. The species appears to be increasing in range and abundance throughout southern Mississippi.

Mississippi's delta region is mainly agricultural with rice a major crop. This crop's irrigation practices have produced major mosquito problems for many years, and insecticide resistance, initially to DDT, developed early in the malaria mosquito and in Psorophora confinnis. The southern portion of Mississippi is mainly forest where vector problems have not affected a large number of people.

A number of other problem species warrant mention. Deer flies have been especially troublesome in the delta area and midges have been numerous in association with reservoirs. Tick populations are reported to be increasing. This is of most significance in the wooded southern portion of Mississippi.

At the state level, Mississippi is almost totally without a vector control program. As a result of changing priorities, qualified vector control personnel have been diverted to other activities. Therefore, the resultant program has been diluted not only in numbers but also in experience.

Future Needs - The improvement of the human health environment in Mississippi is dependent upon actions by the state health agency. The primary health needs in Mississippi are:

1. Improvement of the epidemiological program of the State Board of Health through the development of consistent local contacts and with specific emphasis on water and vector-borne diseases.

2. Expanded water supply program of the State Board of Health to provide essential surveillance and technical assistance to all water systems in the state.

3. Improved protection of sources of water supply from municipal, industrial, and agricultural waste discharges.

4. Planning to protect water supply systems in the event of natural disasters.

5. Revised water quality criteria for primary contact recreation waters.

6. Development of a comprehensive state program to protect the health of the water-oriented recreationist, including water quality monitoring and enforcement powers to restrict public usage of unsafe waters.

7. Revised enabling legislation to permit the operation of vector abatement districts throughout the state.

8. Establishement of ten vector abatement districts in the basin by 1980.

CHAPTER V

WATER AND LAND RESOURCE DEVELOPMENT POTENTIAL

Availability of Land for Development

The basin comprises 8,547,000 acres of land and water. Of this amount, 7,648,000 acres are classified as inventory land as defined by the Conservation Needs Inventory (CNI). The inventory acreage was obtained by subtracting from the total area 448 thousand acres of federal land, 258 thousand acres of urban and built-up areas, and 193 thousand acres of water. Since inventory land is that which is considered potentially available for agricultural use, this physical appraisal is concerned with the inventory acreage.

The primary emphasis of this chapter is the physical potential for development. The economic potential and institutional constraints have not been analyzed in depth.

Cropland Suitable for Regular Cultivation

The inventory acreage for each major land use by capability class is shown in table 5.1. The CNI estimates indicate that 3,518,650 acres are in Classes I through IV which are the lands deemed suitable for row crops when managed within their capabilities. Of this amount, 516,611 acres are Class I, or land which is suitable for continuous cultivation requiring only good cultural practices; 969,632 acres are Class II, or land having certain limitations such as soil slope or erosion that restrict the choice of crops or require moderate conservation treatment; 1,497,551 acres are Class III, or land having severe limitations that restrict the choice of crops or require special conservation practices; and 534,856 acres are Class IV, or land having very severe limitations that restrict the choice of plants or require very special conservation treatment. 1/

In addition, 121,350 acres are in Classes V through VIII and are not suitable for use as cropland due largely to slope conditions or unfavorable soils. Thus of the 3,640,000 acres of cropland, 14 percent is adapted to very intensive cultivation, 27 percent to intensive, 41 percent to moderate, 15 percent to limited, and 3 percent is not recommended for cultivation at all.

1/ The location and intermingling of the classes of soils at times makes it impractical to convert only one class of land. In most cases of land conversion several classes of land are affected.

Table 5.1. Land use by Land Capability Class, Yazoo-Mississippi River Basin, 1970

Land capability class	Total agricultural land	Cropland	Pasture	Forest	Other	Distribution
	Acres	Acres	Acres	Acres	Acres	Percent
I	602,968	516,611	33,857	24,880	27,620	7.9
II	1,489,862	969,632	234,221	221,237	64,772	19.5
III	2,219,174	1,497,551	216,640	450,544	54,439	29.0
IV	1,197,742	534,856	136,358	487,536	38,992	15.6
Total I-IV	5,509,746	3,518,650	621,076	1,184,197	185,823	72.0
V	123,071	35,059	2,282	84,646	1,084	1.6
VI	401,653	21,701	67,064	307,564	5,324	5.3
VII	1,613,530	64,590	252,578	1,281,593	14,769	21.1
VIII	0	0	0	0	0	-
Total V-VIII	2,138,254	121,350	321,924	1,673,803	21,177	28.0
Total	7,648,000	3,640,000	943,000	2,858,000	207,000	100.0

Source: Mississippi Soil and Water Conservation Needs Inventory, 1967, Conservation Needs Committee, Jackson, Mississippi.

Potential Shift from Grassland to Cropland

Additional areas shown by land capability estimates as being susceptible and feasible for development as cropland consists of 484,718 acres of grassland pasture. Much of this acreage could be put into cultivation by simply turning under the sod. The balance would require the application of drainage or erosion control practices and in some instances clearing of scrub timber and brush. Of the 484,718 acres suitable for cultivation, 33,857 acres are Class I, 234,221 acres are Class II, and 216,640 acres are Class III.

Development of suitable grassland into cropland and its incorporation into the cropping system might take several years. The conversion of pasture to crops would reduce the acreage available to pasture unless additional land was diverted to pasture from some other use.

Potential Shift of Forest to Cropland

If cleared and properly cultivated, 24,880 acres now in generally level and fertile forests would make Class I cropland. Another 221,237 acres are suitable for regular cultivation as Class II cropland, if simple erosion control practices are followed, and if the fertility is corrected by adding fertilizers or other soil amendments. An additional 450,544 acres of forests can be converted into Class III cropland with permanent cultivation, but special erosion control and soil management practices would be required. Here in the aggregate are 696,661 acres of forest that could be converted to cropland.

The new acres of land suitable for farming that could be brought into cultivation primarily by clearing forests and installation of necessary drainage systems are quite large. Much of the underdeveloped wetland that is physically feasible to develop for farming requires both drainage and clearing.

The basin with its acreage of suitable land is well adapted for production of food and fiber crops. Alternative costs and returns of placing this land in cultivated crops and improved pasture over returns from production of timber products and grazing should be studied in detail before large scale clearing operations are undertaken. Desirable commercial species already on the forest land, in the long run, may give better returns than would clearing and converting to some other use.

Recommended Shift of Cropland to Grassland and Forests

Partially offsetting the potential shift of grassland and forest to cropland are 121,350 acres of cropland that are best suited to grassland and forests. This is mainly land which has so much slope that it should be kept in continuous sod or tree cover.

Impoundments

There is excellent physical potential for upstream reservoirs in subareas 9 through 13. The existing topography and soil conditions are favorable to obtain adequate storage at average costs. In the remaining portion of the basin, (subareas 1 through 8), the topography is almost flat with no potential impoundment sites.

Potential storage exists in previously planned and potential sites. This division is illustrated in table 5.2. Potential storage in areas covered by the Yazoo and Little Tallahatchie plans are separated also. The average drainage area for sites ranges from 1,650 acres in subarea 12 to 3,300 acres in subarea 10.

Average sediment and floodwater detention varies from 5.4 watershed inches in subarea 11 to 6.1 watershed inches in subarea 10. Average potential storage ranges from 42.0 watershed inches in subarea 9 to 49.5 watershed inches in subarea 13. Two and one-half times the average annual runoff was used as a maximum potential storage for individual impoundments. Previous studies prove this to be the maximum feasible storage for any of the various uses.

These impoundments offer excellent opportunity for recreational, fish and wildlife, irrigation or water quality control uses. Storage for municipal and industrial water seems unlikely since most urban areas are presently using ground water.

Fixed improvements such as highways, roads, utilities, and houses generally are involved when multiple purpose sites are considered. Location and total storage of these sites would be governed by a practical approach to land use.

In addition to upstream reservoirs, there is potential for many on-farm impoundments. These could be used for flood prevention, livestock water, fish farming, recreation, and fish and wildlife. No estimate has been made of this storage potential.

Ground Water Developments

The potential for the development of the ground water resource is very good as the Yazoo-Mississippi River Basin is part of a vast geologic and hydrologic province. Generally, the region is underlain by aquifers that will yield large quantities of water to wells so that ground water is the most readily available source of fresh water.

In delineating the aquifers within the Mississippi embayment in a study by the Geological Survey, it was found that more than one aquifer is available for use and development. In the Yazoo-Mississippi River

Table 5.2. Impoundments planned, constructed, to be constructed, and potential sites plus the potential storage for the sites; Yazoo-Mississippi River Basin, 1970

Subarea	Sites	Drainage area controlled	Extent of area controlled	Committed storage [1/]	Potential storage	Total: Storage	Total: Surface area
	Number	Sq. Miles	Percent	Acre-Feet	Acre-Feet	Acre-Feet	Acres
Area 9							
Planned sites	221						
Constructed	155	445.04	19	145,540	1,041,125	1,186,665	57,127
To be constructed	66	195.14	8	61,613	394,723	456,336	20,019
Potential sites	123	529.35	22	-	1,179,757	1,179,757	59,505
Total sites	344	1,169.53	49	207,153	2,615,605	2,822,758	136,651
Area 11							
Planned sites	117						
Constructed	83	190.60	13	53,966	454,279	508,245	21,933
To be constructed	34	43.99	3	13,488	103,762	117,250	5,875
Potential sites	64	230.02	16	-	552,410	552,410	25,645
Total sites	181	464.61	32	67,454	1,110,451	1,177,905	53,453
Areas 10, 12, 13							
Planned sites	99						
Constructed	56	85.19	3	27,159	207,043	234,202	11,947
To be constructed	43	109.60	4	34,704	259,900	294,604	16,741
Potential sites	150	659.97	23	-	1,646,003	1,646,003	80,693
Total sites	249	854.76	30	61,863	2,112,946	2,174,809	109,381
Summary Areas 9-13							
Planned sites	437						
Constructed	294	720.83	11	226,665	1,702,447	1,929,112	91,007
To be constructed	143	348.73	5	109,805	758,385	868,190	42,635
Potential sites	337	1,419.34	21	-	3,378,170	3,378,170	165,843
Total sites	774	2,488.90	37	336,470	5,839,002	6,175,472	299,485

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes storage for sediment, floodwater, recreation, fish and wildlife.

Basin, there are between two to five aquifers so available and there are at least four such aquifers available over 75 percent of the basin. In many areas only the shallowest aquifer has been used or is being used as a source of water supply.

The Quarternary alluvial aquifer of the Yazoo-Mississippi River Basin is one of the most prolific sources of ground water. This aquifer covers the delta portion of the basin area. It is a desirable source of water for irrigation and industry, but is used for public supplies only where an ample supply of water of better quality is not available from the deeper aquifers. The water is generally a hard to very hard calcium bicarbonate or calcium magnesium bicarbonate type containing excessive iron.

Most industrial and irrigation wells are less than 150 feet deep. Yields of 500 gallons per minute or more are common over a large percent of the alluvial plain, and yields of more than 5,000 gallons per minute have been reported. The water levels are generally less than 20 feet below the land surface. In view of the foregoing, well development costs are minimal which will enhance the use of wells to develop the ground water potential from this aquifer.

The principal source of recharge is precipitation. However, some recharge occurs locally along streams during high stages, but generally ground water is discharged to the streams.

The Tertiary aquifers include the lower Wilcox, the middle Wilcox, the Meridian-Upper Wilcox, the Tallahatta Formation, Winona Sand, Sparta Sand, the Cockfield Formation and Forest Hill Sand, the Vicksburg Group, and the Catahoula Sandstone as water supplies. In much of the area, two or more Tertiary aquifers are available for development, although generally only the shallowest aquifer is used. Most of the Tertiary aquifers are areally extensive, and some contain fresh water at depths in excess of 2.0 thousand feet. These aquifers are recharged by precipitation on the outcrop and by downward percolation of water from overlying alluvium where the outcrops are covered by Quaternary deposits.

Flowing wells can be obtained from Tertiary aquifers in a few low-lying areas associated with major streams. Only one aquifer, the Sparta Sand, shows signs of pending or possible local over-development. Collectively, the Tertiary aquifers are capable of sustaining more extensive development, and some aquifers are untapped by wells in large areas where they contain fresh water.

The Cretaceous aquifers include the Gordo, the Eutaw, the Ripley Formations, and also the Coffee Sands. Generally, the aquifers are not intensively developed but they do yield fresh water in some counties in the northeast part of the basin. Wells commonly yield 500 gallons per minute.

The aquifers are recharged primarily by precipitation on the outcrop. Because the aquifers are saturated, most of the streams crossing the Cretaceous outcrop area receive water from the aquifers during periods of no precipitation; therefore, most of the streams are perennial.

Most of the general water level declines are the result of unrestricted flow from wells and of municipal and industrial withdrawals, and are not indicative of over-development of the aquifers. As additional supplies are developed, the water levels will decline, and many of the wells which now flow will then have to be pumped.

Channel Improvements and Levees

The potential for using channels and levees for reducing floodwater damages in the basin exists in both the upland and delta. The use of these measures in any location depends on the degree of development, land use, and cost of the measures imposed by natural and man-made features.

The upland areas generally have valley slopes that require costly design features to develop stable channels. Environmental considerations may also limit the use of channel measures. In addition, cultural features such as highways, railroad and road locations, utility locations, and urban and built-up areas, when involved with channel work, usually result in increased costs and may be so restrictive that nothing economical can be done. All future cultural features should avoid conflicts with present and future channels where possible, but in any event the stream systems should get consideration to avoid conflicts.

Levees in the upland areas have limited use as floodplains are narrow and urban-type developments are limited in the floodplains. If floodplain developments occur in the future, a need for levees could develop. However, local interests should be made aware of all flood prone areas as soon as these data are available. Hopefully, the availability of this data should limit future developments in these flood prone areas.

The delta area or Southern Mississippi Valley Alluvium Land Resource Area has the most potential for channels, levees, and a combination of channels and levees to reduce floodwater damages. As more intensive agriculture develops, the need should become greater. Environmental considerations and cultural features do impose some restrictions. The need for channels exists throughout the delta. Except for urban and built-up areas and along some of the major streams, the potential for levees to reduce damages is limited.

The potential for using a combination of channels and levees to reduce damages exists along the delta streams that originate in uplands.

Many of these streams presently have channels and levees that are inadequate as frequent levee breaks occur.

The potential of using channels and levees along with pumping plants to reduce floodwater damages also exists in a few locations throughout the delta. Usually, when these are developed major river overflow areas are reduced.

Irrigation Systems

There are shortages of water from natural sources (rainfall and available moisture in the soil) to supply the water requirements of crops and pastures for their consumptive use during their entire growing seasons every year although the average annual rainfall of the basin is about 52 inches, and the average annual runoff is about 18 inches, leaving some 34 inches for absorption, infiltration, evapo-transpiration or utilization. Therefore, there are opportunities for the addition of supplemental irrigation water to any or all crops grown in the basin. These opportunities for supplemental irrigation are limited only by the availability of land suited for irrigation, water supply for irrigation, and crops responsive to irrigation.

There are 5.5 million acres in land capability Classes I-IV that are potentially irrigable (table 5.3). The water requirements to irrigate the 5.5 million acres of potentially irrigable soils are estimated to be about 11.7 million acre feet, or the equivalent of about 10,445 mgd for the entire year.

There is sufficient water available (either from underground sources or from the storage of surface runoff in reservoirs or from the Mississippi River and other surface streams) to supply that needed for irrigation.

The potential for development is very good with the rate of development depending upon labor costs, demand for agricultural crops, management levels, and cost decreasing technological advances in irrigation.

Table 5.3. Potentially irrigable soils by land resource area, Yazoo-Mississippi River Basin, 1970

Land Resource Area	Acres	Percent
131	3,781,300	68.39
133	663,200	12.00
134	1,084,400	19.61
Total	5,528,900	100.00

Source: Soil Conservation Service, United States Department of Agriculture.

Water Quality Control

Water quality criteria for interstate and intrastate waters for Mississippi have been established by the Mississippi Air and Water Control Commission. These criteria, adopted April 24, 1973, have been approved by the Environmental Protection Agency. The policy inherent in the standards, as stated in Section I of the criteria, shall be to protect water quality existing at the time these water quality standards were adopted or to upgrade or enhance water quality within the State of Mississippi.

The criteria apply at all stages of streamflow that exceed the seven day, ten year minimum flow in unregulated, natural streams. Minimum conditions applicable to all waters and specific water quality criteria relating to use have been established for the state. In addition, most state bays, lakes, reservoirs, rivers, bayous, and creeks have been classified as to water use.

The minimum conditions that apply to all waters follow. The waters shall be (1) free from substances attributable to municipal, industrial, agricultural, or other discharges that will settle to form putrescent or otherwise objectional sludge deposits, (2) free from floating debris, oil scum, and other floating materials attributable to municipal, industrial, agricultural, or other discharges in amounts sufficient to be unsightly or deleterious, (3) free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, or other conditions in such a degree as to cause a nuisance, and (4) free from substances attributable to municipal, industrial, agricultural, or other discharges in concentrations or combinations which are toxic or harmful to humans, animal, or aquatic life. An additional condition is that municipal, industrial, or other wastes shall receive effective treatment or control (secondary or equivalent) in accordance with the latest practical technological advances and shall be approved by the Commission and that a degree of treatment greater than secondary will be required when necessary to protect legitimate water uses.

The specific water quality criteria have been established for four uses, namely, public water supply, shellfish harvesting areas, recreation, and fish and wildlife. Standards for the four uses include among others, dissolved oxygen, pH, temperature, bacteria, specific conductance, dissolved solids, toxic substances, taste and odor, and phenolic compounds.

Section IV of the criteria provides a classification of water uses for most of the state's bays, lakes, reservoirs, rivers, bayous, and creeks. These classifications are also public water supply, shellfish harvesting areas, recreation, and fish and wildlife. In the Yazoo-Mississippi River Basin, 85 waters have been classified into either a recreation or a fish and wildlife use. No streams or waters are classified for other uses.

Water Table Control

Although Mississippi currently is not faced with ground water problems at a magnitude found in some other states, a serious ground water situation is imminent in some localities, and other localities are approaching a serious condition. Water levels in artesian aquifers in Mississippi have declined at rates of one and two feet per year with areas of large withdrawals experiencing even greater declines.

Mississippi does not, at this time, have any legislation governing ground water withdrawals. Senate Bill 2049, to enable the creation of ground water districts in critical areas, was passed by the Senate during the 1974 Session of the Mississippi Legislature but failed to get on the House calendar.

The people of Mississippi recognize and need to act upon the problems associated with the ever-increasing ground water withdrawals. Regulation for the use of this valuable resource is mandatory, according to the Mississippi Board of Water Commissioners, to best utilize and develop this natural resource.

Recreation

There is a need for extensive development of some recreation facilities in the basin. These facilities include swimming pools, play fields, tennis courts, 18-hole golf courses, boat slips, picnic tables, nature trails, hiking trails, horse trails, and bicycle trails.

There is adequate land and water area in the basin for the development of all of these facilities providing it is made accessible to the public. Swimming pools, play fields, golf courses, tennis courts, and bicycle trails are primarily associated with urban and built-up lands. The needs for these facilities can be easily met by planning for their development in urban expansion and making funds available for construction through federal, state, county, and city tax monies.

Nature trails, hiking trails, and horse trails are closely associated with forest lands. The greatest need is for nature trails with a demand of 43 thousand acres by the year 2020. Much of this need can be met by developing trails in buffer zones of existing forest recreation areas. The remaining need can be met on federal, state, county, or municipally-owned lands within the basin through careful planning and development. Demands for hiking trails and horse trails will be more difficult to meet because development of this type requires continuous ownership patterns for five to 30 miles. Some of the needs can be met by developing trails on National Forest lands and around the four large reservoirs in the uplands portion of the basin. This would, however, leave the delta and bluff hills portions almost void of these

facilities. To fully meet the demands for trails will require an active long-range planning and acquisition program to insure rights-of-way for these facilities.

Boat docking facilities are directly related to large water areas. There is an ample supply of water surface area for the needed development of 9,000 boat slips by the year 2020. These facilities will be developed at a rate compatible with economic demands for this convenience type service.

There is a heavy influx of non-resident use in the uplands primarily from the metropolitan area of Memphis, Tennessee. The greatest demands for recreation facilities by tourists are camping, swimming, boating, and sightseeing. Boating, swimming, and sightseeing facilities are sufficient to meet tourism demands through the year 2020, but camping facilities are not. A detailed study is needed to accurately determine demands on basin facilities by tourism. There are sufficient suitable sites available for added development providing these sites are identified and reserved in an early action program. A detailed study will greatly aid in planning for this program.

Fish and Wildlife

The development of competing resources, cropland, pasture land, urban areas, or intensive timber management programs, will reduce the possible potential for wildlife and fishery habitat.

Wildlife thrives best in habitat composed of diverse types. Developments which tend to reduce the numbers, kinds, or quality of diverse types will bring about a deterioration in wildlife habitat. This is painfully clear in the delta.

The intensive agricultural development of this fertile land has reduced forest game habitat to a pittance of its original magnitude. Delta lakes have likewise been reduced in number, size, depth, and productivity by agricultural encroachment and pollution. There is very little potential for fishery or game habitat development in the delta.

Waterfowl developments are possible in the delta. As long as the continental waterfowl flock remain a viable population, the winter time habitat of the delta can be expected to attract a segment of this migratory population. The potential for development of farmlands and public lands is plentiful. Shallow impoundments are easily constructed in the delta "ridge and depression" topography and such impoundments are attractive to all "dabbling" ducks.

Upland potential for game and fishery developments far exceeds that of the delta. There is ample room for expansion of the fishery resource

base through construction of small and large impoundments. Upland game habitat, though generally less productive than delta habitat, is much more abundant and likely to remain so for years to come. There are areas in the uplands not yet fully stocked with deer and turkey which have potential for expansion of these populations.

Associated Land Treatment and Land Use Adjustment

Proper land treatment is essential for good land use. In addition, conservation treatment is the basic element for a sound watershed protection, flood prevention, and agricultural water management program. Presently, land treatment programs are in operation in the basin through the assistance and cooperation of the soil and water conservation districts of Mississippi. The Yazoo River and Little Tallahatchie Watershed Projects and the Northwest Mississippi Resource Conservation and Development Project, among the programs, have accelerated the rate of conservation treatment in the basin over the rate in most adjacent areas.

However, the potential for continuing the rate of conservation treatment and for making any needed land use adjustments is affected by economic factors and established customs and patterns of farming. These factors and customs can be overcome by programs that would include technical assistance, education and information, and effective cost-sharing in the application of practices. Presently no physical conditions exist that would restrain or limit land treatment installation in the basin.

Land use changes and adjustments in the basin must occur if the demands for food and fiber production and forest products are to be met. These land use adjustments will also require installation of conservation treatment measures. Generally, land use adjustments in conversion of cropland to grassland or forest should occur on the steeper lands. However, overall land use shifts in the future probably will result in increased cropland and pasture acres and in decreased forest acres.

All land use shifts require that proper conservation treatment measures be installed and proper management be carried out so that problems of the basin are not increased.

CHAPTER VI

EXISTING WATER AND RELATED LAND RESOURCE PROJECTS AND PROGRAMS

Soil Conservation Service

The Soil Conservation Service is a technical agency of the U.S. Department of Agriculture charged with the responsibility of developing and carrying out a national soil and water conservation program. The Service provides technical assistance primarily through Soil and Water Conservation Districts to help individuals, groups, and units of government to develop and carry out soil and water conservation plans.

Soil Conservation Service Establishing Act (Public Law 46)

In April 1935, the Congress of the United States passed the Soil Conservation Service Establishing Act (PL-46). This act provided means for the Secretary of Agriculture, through the Soil Conservation Service, to work with individual landowners in soil conservation districts in protecting land resources against soil erosion and for other purposes. The first districts were organized in 1939. Since that time all counties in the basin have been organized into soil conservation districts and are actively engaged in carrying out soil and water conservation programs with landowners.

To date, detailed soil surveys have been completed on approximately 92 percent of the agricultural land. Farm plans have been completed on 91 percent of the agricultural land. Land treatment measures for watershed protection applied to date include conservation cropping systems, pasture planting and improvements, farm ponds, drainage, terracing, contour farming, critical area treatment, tree planting, and forest management practices, among others. Land treatment measures applied on the land as of 1973 through PL-46 and other going programs are included in table 6.1.

Flood Control Act (Public Law 534)

The Flood Control Act enacted by Congress in 1944, authorized the Department of Agriculture to assist, among other items, with floodwater and sediment problems on agricultural land in eleven large river basins. The Little Tallahatchie River Watershed and the Yazoo River Watershed, both located in the Yazoo-Mississippi River Basin, are included in the eleven basins and comprise about 58 percent of the entire basin area.

Table 6.1. Land treatment measures now on the land, Yazoo-Mississippi River Basin, as of June 30, 1973 1/

Item description	Unit	Subarea				Total
		Area 1-8	Area 9	Area 11	Areas 10, 12, & 13	
Conservation cropping system	Ac.	2,361,157	282,193	191,817	366,176	3,151,343
Grass waterway or outlet	Ac.	426	860	2,443	2,651	6,380
Pasture and hayland planting	Ac.	77,064	143,827	153,716	235,644	610,251
Pasture and hayland management	Ac.	95,664	441,590	389,590	490,607	1,417,451
Pond	No.	541	8,221	4,604	6,537	19,903
Drainage main or lateral	Mi.	6,623	1,987	327	965	9,902
Drainage field ditch	Mi.	12,753	680	243	518	14,194
Diversion	Mi.	2	440	392	851	1,685
Crop residue management	Ac.	2,149,809	432,085	353,495	560,409	3,495,798
Terraces	Mi.	--	27	919	77	1,023
Wildlife habitat management	Ac.	405,301	53,966	195,597	231,520	886,384
Wildlife watering facility	No.	28	59	35	61	183
Drainage land grading	Ac.	127,288	--	--	1,078	128,366
Irrigation system	No.	2,192	4	--	7	2,203
Irrigation water managment	Ac.	319,780	70	--	219	320,069
Irrigation storage reservoir	No.	30	14	--	8	52
Irrigation system tailwater recovery	No.	419	--	--	--	419
Stream bank protection	Mi.	454	49	222	350	1,075
Tree planting	Ac.	21,259	90,035	136,168	217,944	465,406
Woodland improved harvesting	Ac.	31,635	39,111	47,960	104,065	222,771
Woodland improvement	Ac.	37,260	38,993	95,434	152,794	324,481
Critical area planting	Ac.	2,166	283,125	215,114	287,455	787,860
Clearing and snagging	Mi.	324	141	32	136	633

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Recurring reporting in some practices make acres exceed total acres in crops, and pasture.

Preparation of work plans started in the two watersheds - Little Tallahatchie River and Yazoo River - in 1947 on areas that ranged in size from 5,000 to 20,000 acres and continued until 1954. These so called "minor watersheds", sponsored by the commissioners of the various soil conservation districts provided primarily for land treatment measures and, in some plans, for channel improvements. Seventy-two of these minor watersheds were planned during this period on a total area of 2.7 million acres.

After 1954, watershed work plans were prepared - planning is still in progress for subwatersheds that ranged in size generally from about 10 thousand to 100 thousand acres in size. Watershed management or drainage districts sponsor these projects and soil conservation districts are co-sponsors. The sponsors have legal authority to install, operate, and maintain the various measures. The work plans include both land treatment and structural measures. Work plans have been developed on 61 subwatersheds or parts of subwatersheds covering about 3.1 million acres. Some of the minor watershed work plans prepared before 1954 have been grouped and replanned on a subwatershed basis.

As of June 30, 1973, the Tallahatchie River Watershed had 18 watersheds in the operation stage on a total of about 563 thousand acres. Table 6.2 provides data on watershed planning in these flood prevention projects by areas. The location and status of these watershed projects are shown on map 6.1. Table 6.3 presents data on installed and to be installed reservoir impoundment sites in the watershed (area 11). Physical data, costs, and benefits of these watershed projects are shown in table 6.4.

Also, as of June 30, 1973, the Yazoo River Watershed had 58 watersheds in the operations, planning, and authorized for planning stage on a total of about 3,371,742 acres (table 6.2). The location and status of these watershed projects are shown on map 6.2. Table 6.3 presents data on installed and to be installed reservoir impoundment sites in the Yazoo River Watershed (areas 9, 10, 12, and 13). Physical data, costs, and benefits of these watershed projects are shown in table 6.4.

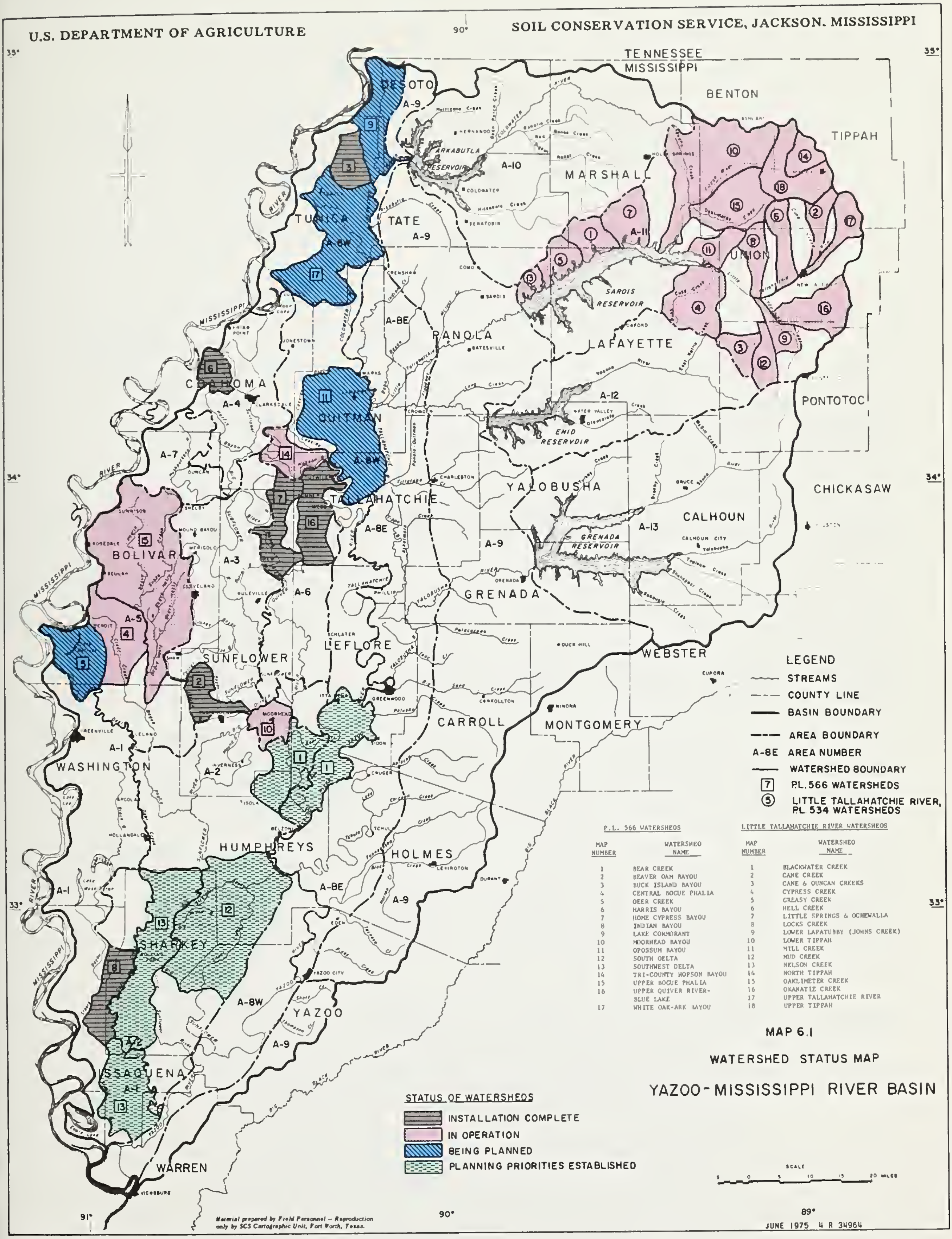
Watershed Protection and Flood Prevention Act (Public Law 566)

The Watershed Protection and Flood Prevention Act (PL-566) authorizes the Secretary of Agriculture to cooperate with state and local agencies in planning and implementing water and related land programs and projects. Watershed projects under this act are limited to the basin area not included in the Yazoo River and Little Tallahatchie River Flood Prevention Projects. Therefore, these watershed projects are limited to the delta, subareas 1 through 8W, excluding 8E.

Table 6.2. Status of PL-534 Watershed Planning, Yazoo-Mississippi River Basin

Subarea	Watersheds projects							
	In operation		Being planned		Authorized for planning		Totals	
	Total	Extent of area coverage	Total	Extent of area coverage	Total	Extent of area coverage	Total	Extent of area coverage
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Delta								
8E	4	21	1	1	1	9	6	31
Upland								
9	23 1/	87	-	-	-	-	23	87
10	7 2/	86	-	-	-	-	7	86
11	18 3/	60	-	-	-	-	18	60
12	7 4/	52	-	-	1	19	8	71
13	12 5/	73	1	4	1	7	14	84
Total	71	67	2	1	3	4	76	72

Source: Soil Conservation Service, United States Department of Agriculture.
1/ Eight projects essentially complete.
2/ Four projects essentially complete.
3/ Five projects essentially complete.
4/ One project essentially complete.
5/ Two projects essentially complete.



MAP 6.1

WATERSHED STATUS MAP

YAZOO-MISSISSIPPI RIVER BASIN

USDA-SCS-FORT WORTH, TEX. 1975

Table 6.3. Reservoir impoundment data, PL 534 watersheds installed, and to be installed sites, storage, and surface acres, Yazoo-Mississippi River Basin, as of June 30, 1973

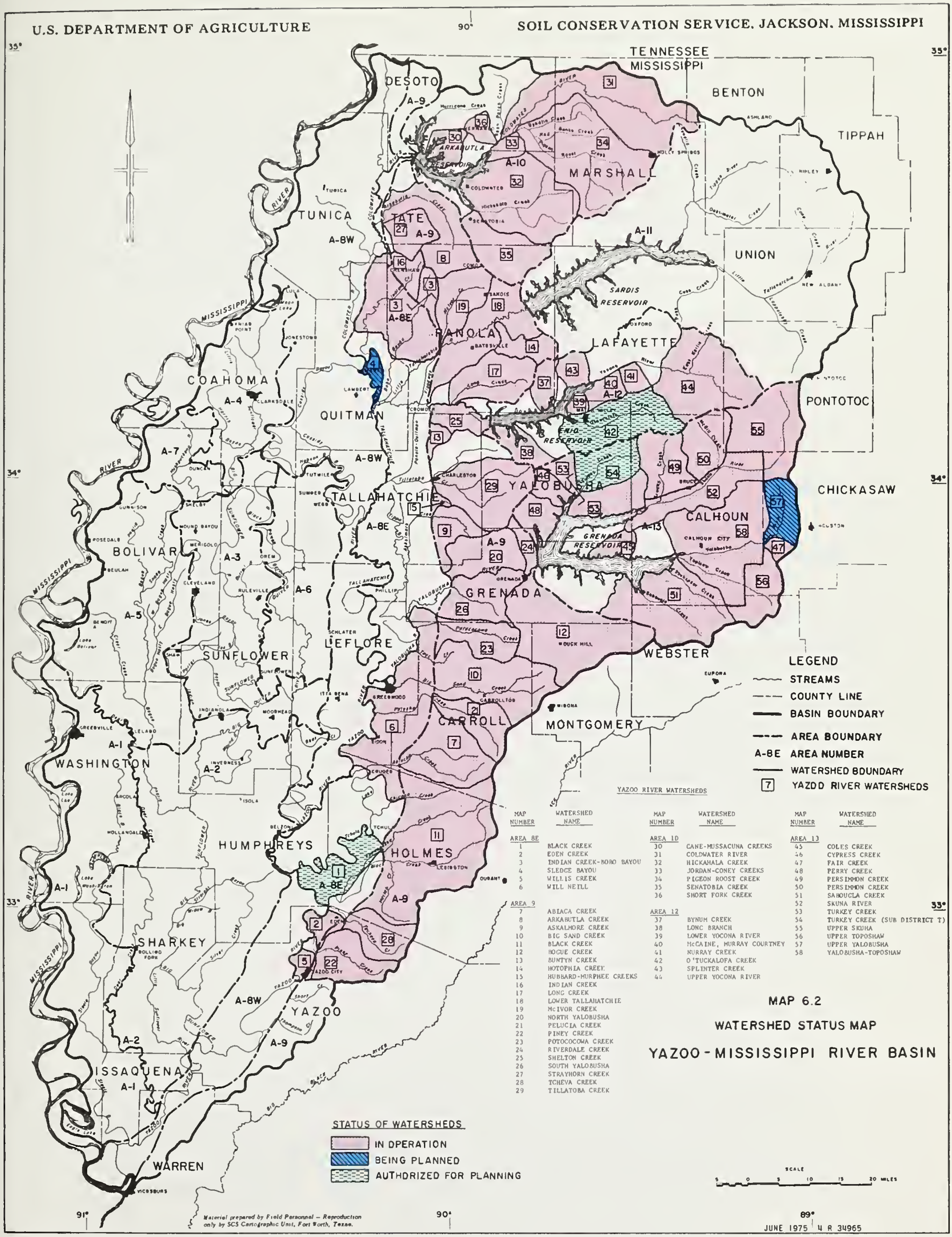
Item	Unit	Subarea 9	Subarea 10, 12 and 13	Subarea 11	Total
Installed					
Sites	Number	155	56	83	294
Storage					
Normal pool	Ac. Ft.	29,892	4,459	7,348	41,699
Floodwater pool	Ac. Ft.	115,648	22,700	46,618	184,966
Total	Ac. Ft.	145,540	27,159	53,966	226,665
Surface area					
Normal pool	Acres	4,410	1,313	1,824	7,547
Floodwater pool	Acres	13,289	3,884	5,988	23,161
To be Installed					
Sites	Number	66	43	34	143
Storage					
Normal pool	Ac. Ft.	9,490	6,074	3,154	18,718
Floodwater pool	Ac. Ft.	52,123	28,630	10,334	91,087
Total	Ac. Ft.	61,613	34,704	13,488	109,805
Surface area					
Normal pool	Acres	2,012	1,207	657	3,876
Floodwater pool	Acres	6,933	4,164	1,708	12,805
Total					
Sites	Number	221	99	117	437
Storage					
Normal pool	Ac. Ft.	39,382	10,533	10,502	60,417
Floodwater pool	Ac. Ft.	167,771	51,330	56,952	276,053
Total	Ac. Ft.	207,153	61,863	67,454	336,470
Surface area					
Normal pool	Acres	6,422	2,520	2,481	11,423
Floodwater pool	Acres	20,222	8,048	7,696	35,966

Source: Soil Conservation Service, United States Department of Agriculture.

Table 6.4. Existing PL 566 and PL 534 watershed project data, Yazoo-Mississippi River Basin

Subarea	Total area	Floodwater retarding and multi-purpose structures: Drainage area controlled	In-stalled	To be in-stalled	Stream development: In-stalled	To be in-stalled	Total installation cost land treatment measures	Total installation cost of structural measures	Total annual costs	Total annual benefits	Benefit-cost ratio
	Acres	Acres	Number	Number	Miles	Miles	Thou. dollars	Thou. dollars	Dollars	Dollars	
Delta											
PL 566 Area 1-8W	547,526	-	-	-	779	-	4,066.1	6,562.7	369,977	1,200,090	3.2:1
PL 534 Area 8E	154,120	-	-	-	75	219	4,520.5	4,144.0	291,603	635,557	2.2:1
Upland											
PL 534 Area 9	1,318,614	409,783	155	66	17	84	18,839.4	18,706.0	1,374,804	3,253,885	2.4:1
Area 11	562,876	150,136	83	34	199	121	6,807.3	12,049.1	911,072	1,820,149	2.0:1
Areas 10, 12, 13	1,336,132	124,753	56	43	303	258	13,487.7	17,724.6	1,367,511	2,792,097	2.0:1
Total	3,919,268	684,672	294	143	1373	682	47,721.0	59,186.4	4,314,967	9,701,778	2.2:1

Source: Soil Conservation Service, United States Department of Agriculture.



YAZOO RIVER WATERSHEDS

MAP NUMBER	WATERSHED NAME
AREA 8E	
1	BLACK CREEK
2	EDEN CREEK
3	INDIAN CREEK-BORO BAYOU
4	SLEDGE BAYOU
5	WILLIS CREEK
6	WILL NEILL
AREA 9	
7	ABIACA CREEK
8	ARKABUTLA CREEK
9	ASKALMORE CREEK
10	BIG SAND CREEK
11	BLACK CREEK
12	BOGUE CREEK
13	BUNTYN CREEK
14	HOTOPHIA CREEK
15	HUBBARD-MURPHEE CREEKS
16	INDIAN CREEK
17	LONG CREEK
18	LOWER TALLAHATCHIE
19	McIVOR CREEK
20	NORTH YALOBUSHA
21	PELUCIA CREEK
22	PINEY CREEK
23	POTOCOCOWA CREEK
24	RIVERDALE CREEK
25	SHELTON CREEK
26	SOUTH YALOBUSHA
27	STRAYHORN CREEK
28	TCHEVA CREEK
29	TILLATOBA CREEK
AREA 10	
30	CANE-MUSSACUNA CREEKS
31	COLDWATER RIVER
32	HICKAHALA CREEK
33	JORDAN-CONEY CREEKS
34	PIGEON ROOST CREEK
35	SENATOBIA CREEK
36	SHORT FORK CREEK
AREA 12	
37	BYNUM CREEK
38	LONC BRANCH
39	LOWER YOCONA RIVER
40	McCAINE, MURRAY COURTNEY
41	NURRAY CREEK
42	O'TUCKALOFA CREEK
43	SPLINTER CREEK
44	UPPER YOCONA RIVER
AREA 13	
45	COLES CREEK
46	CYPRESS CREEK
47	FAIR CREEK
48	PERRY CREEK
49	PERSIMMON CREEK
50	PERSIMMON CREEK
51	SABOUGLA CREEK
52	SKUNA RIVER
53	TURKEY CREEK
54	TURKEY CREEK (SUB DISTRICT T)
55	UPPER SKUNA
56	UPPER TOPOSHAW
57	UPPER YALOBUSHA
58	YALOBUSHA-TOPOSHAW

MAP 6.2

WATERSHED STATUS MAP

YAZOO-MISSISSIPPI RIVER BASIN

USDA-SCS-FORT WORTH, TEX. 1975

Seventeen PL-566 watersheds, totaling 1,461,141 acres, are included in the basin area. Tables 6.5 and 6.6 show the status of these 17 projects. The location and status of these watersheds are also shown on map 6.1. Six of these watershed projects totaling 212,531 acres are complete; four projects totaling 334,995 acres are under construction. Four other projects totaling 362,879 acres are being planned. The remaining three watershed projects totaling 550,736 acres have planning priority established.

The estimated total cost for all planned and installed measures in the ten watersheds that are under construction or completed is $10,628,800. Land treatment measures costs on 317,200 acres amounts to $4,066,100. Structural measures costs that are primarily channel work total $6,562,700. Table 6.4 presents physical data, costs, and benefits for these seven PL-566 watersheds.

Resource Conservation and Development Projects

The Food and Agriculture Act of 1962 (Public Law 87-703) and other authorities authorize the United States Department of Agriculture (USDA) to provide qualified local groups technical and financial help, through the Resource Conservation and Development (RC&D) Program, in conserving and developing their natural resources. This assistance is provided to authorized multi-county RC&D projects.

The areas of two authorized RC&D projects include most of the Yazoo-Mississippi River Basin. These projects are locally initiated, sponsored and directed. Each is large enough to enable local leaders to carry out project plans for conservation and development of natural resources for economic improvement and community betterment.

Project plans of the two authorized projects recognize the problems and needs, outline objectives and goals of project sponsors, including opportunities and courses of action. Project activities and actions result in improvements in conservation and development of natural resources and improvements in local enterprises such as agriculture, industry, and recreation.

The Northwest Mississippi Resource Conservation and Development Project was approved in 1966 and expanded in 1971. The project area includes 14 counties. Counties located entirely in the basin include Bolivar, Coahoma, Humphreys, Issaquena, Leflore, Quitman, Sharkey, Sunflower, Tunica, and Washington. Also, parts of the other RC&D Counties, Carroll, Holmes, Tallahatchie, and Yazoo, are located in the basin. In the future, DeSoto, Grenada, Montgomery, Panola, Tate, and Yalobusha Counties may be included in the project area.

Table 6.5. Status of PL-566 watersheds, Yazoo-Mississippi River Basin, June 1974

	Watershed name	Location (county)	Planning priority established	Being planned	Approved for operations	Installation complete
1.	Bear Creek	Leflore Humphreys Sunflower	X			
2.	Beaver Dam Bayou	Sunflower				X
3.	Buck Island Bayou	Tunica				X
4.	Central Bogue Phalia	Bolivar			X	
5.	Deer Creek	Washington Bolivar		X		
6.	Harris Bayou	Coahoma				X
7.	Home Cypress Bayou	Sunflower Coahoma Tallahatchie				X
8.	Indian Bayou	Issaquena Sharkey				X
9.	Lake Cormorant	Tunica DeSoto		X		
10.	Moorhead Bayou	Sunflower			X	
11.	Oppossum Bayou	Tallahatchie Quitman		X		
12.	South Delta	Sharkey Yazoo Humphreys	X			
13.	Southwest Delta	Sharkey Issaquena Warren Washington	X			
14.	Tri-County Hopson	Quitman Tallahatchie Coahoma			X	
15.	Upper Bogue Phalia	Bolivar Washington			X	
16.	Upper Quiver River-Blue Lake	Tallahatchie Sunflower				X
17.	White Oak-Ark Bayou	Tunica Quitman Coahoma		X		

Source: Soil Conservation Service, United States Department of Agriculture.

Table 6.6. Status of PL-566 watershed planning, Yazoo-Mississippi River Basin

Subarea	Watershed Projects: Installation complete: Total	Installation complete: Extent of area coverage	In operation: Total	In operation: Extent of area coverage	Being planned: Total	Being planned: Extent of area coverage	Planning priorities established: Total	Planning priorities established: Extent of area coverage	Total	Extent of area coverage
Number	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1	1	7	-	-	-	-	-	14 2/	1	21
2	-	-	-	-	-	-	2	50 3/	2	50
3	1	7	1	6	-	-	-	-	2	13
4	1	11	-	-	-	-	-	-	1	11
5	-	-	2	68	1	10	-	-	3	78
6	2	41	-	-	-	-	-	-	2	41
7	-	-	-	-	-	-	-	-	-	-
8W	1	3	1	3	3	32 1/	1	8	6	46
Total	6	6	4	9	4	10	3	15	17	40

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes a portion of Lake Cormorant Watershed that lies in Area 9.
2/ Includes a portion of Southwest Delta Watershed.
3/ Includes a portion of Bear Creek Watershed.

The Northeast Mississippi Resource Conservation and Development Project was approved in 1968 and expanded in 1973. The project area includes 22 counties. All or parts of nine project counties are located in the basin. All of Calhoun and Lafayette are located in the basin; parts of Benton, Chickasaw, Marshall, Pontotoc, Tippah, Union, and Webster are located in the basin. The other 13 project counties are Alcorn, Choctaw, Clay, Itawamba, Kemper, Lee, Lowndes, Monroe, Noxubee, Oktibbeha, Prentiss, Tishomingo, and Winston.

U. S. Forest Service

National Forest Systems

Holly Springs National Forest - The Holly Springs National Forest was established in 1936 and consists of 140 thousand acres of federal lands intermingled with approximately 262 thousand acres of privately-owned property in Marshall, Benton, Tippah, Union, and Lafayette Counties.

Since its inception, the more intensive forest management has enhanced the environmental quality of the area. Soil erosion has been reduced, fires reduced, timber volumes increased, and the recreation potential enhanced.

Timber growing stock volume increased from 274 cu. ft./ac. in 1950 to 549 cu. ft./ac. in 1970. The present harvest is over 8 million board feet of softwood sawtimber per year.

The improved techniques, equipment, and strategies used in fire prevention and suppression have reduced the average annual acres burned from 1,830 in the 1930's to just 92 acres in the 1960's.

The small federal tracts dispersed throughout the purchase unit create management problems. Land exchanges are being used to consolidate the ownership to improve the management efficiency of the forest.

The forest has two developed recreation sites with 76 camping units and 65 picnicking units. Hunting is the primary forest recreation use. Urban influence from the city of Memphis, Tennessee, accounts for much of the recreation use which is about 170 thousand visitor days per year.

Delta National Forest - The Delta National Forest consists of 59 thousand acres of bottomland hardwoods in Sharkey and Issaquena Counties. It is one of few forested areas in the entire Mississippi River alluvial valley with some stands of virgin timber. Management

techniques are highly favorable toward waterfowl with one greentree reservoir consisting of 1.7 thousand acres. Currently, the forest is producing 2.5 million board feet of quality hardwood sawtimber. Two recreation areas provide eight camping units for picnicking, fishing, boating, and hiking.

The combined management policies of the two National Forests are as follows: modifying timber site preparation on highly erosive soils; prelocate logging roads and skid trails on all timber sales; select timber stands 20 to 50 acres in size to establish and protect wildlife habitat; modify forest management practices along water or travel corridors to enhance visual quality; seed exposed soil and stablize roadbanks by sloping and seeding; cooperate with other federal, state, and local organizations to improve the quality of the National Forest; and help to protect the quality of the environment and serve as long term management guides.

State and Private Forestry

Cooperative Forest Management (CFM) Program - This program was authorized under Public Law 81-729 (64 Stat. 73), as amended, to improve the management of small private forests and the operations of loggers and small plants processing primary forest products with special attention to maintaining and improving the quality of the environment.

The program is administered by the U. S. Forest Service through the state forestry agencies who provide on-site technical assistance in such activities as preparing forest management plans for the production of timber, wildlife, water, recreation, forage, and other forest values.

Tree Seedling Production (CM-4) - Assistance is authorized under Section 4 of the Clarke-McNary Act of June 1924, as amended; Public Law 68-270 (43 Stat. 653). Both financial and technical assistance are provided to cooperating states for seed or seedling production to be used in multiple-use forest, windbarrier, and watershed plantings on private and non-federal public lands.

Forest Products Utilization (FPU) - The objective of the Forest Products Utilization Program is to extend the supply of our nation's forest resources and protect and enhance the environment through more efficient utilization of forest products.

Working toward these goals, both Forest Service and State Forest Products Utilization personnel provide technical assistance of a highly specialized nature to timber harvesters and processors throughout the nation.

General Forestry Assistance (GFA) - This program provides highly specialized forestry services to support state forestry organizations and others in their efforts to enhance rural community development and increase the production of forest products under sound principles of resource management.

Assistance provided under the GFA program includes resource management advice to other federal, state, and local government landholding agencies; large private owners, forestry consultants, and other individuals and groups; loggers and processors; local and state groups; and regional planning and development groups. Intensive training of Forest Service and State Forestry personnel and others is required in highly specialized fields to increase professional competence.

Yazoo-Little Tallahatchie Flood Prevention Project

The Flood Prevention Act of 1944 authorized the Department of Agriculture to begin the upstream land treatment phase of the Yazoo-Little Tallahatchie Flood Prevention Project. In 1947, working through established soil conservation districts, the United States Department of Agriculture started the land treatment. The Soil Conservation Service and Forest Service are responsible for providing on-the-ground leadership, technical assistance, and financial help. The land treatment is carried out on private lands through cooperative agreements with the landowners. At present, over 300 thousand acres of badly eroded open lands have been reforested, and 250 thousand acres of forest lands have been improved.

Research

There are two forest research laboratories in the basin, one located at Oxford, and the other at Stoneville. Both are extensions of the Southern Forest Experiment Station.

The laboratory located at Oxford is charged with hydrology studies in the upland portion of the basin. Much valuable flood control and watershed management information is gained through the various studies.

The laboratory at Stoneville is active in silvicultural studies of Mississippi Delta bottomland hardwoods. Much important knowledge has been gained about the propogation and growth of eastern cottonwood. Other studies include; forest insects, damage caused and their control; diseases peculiar to hardwood forest species; reforestation methods with hardwoods; and water requirements of bottomland hardwoods.

Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service (ASCS) has responsibility for providing cost sharing to farmers for implementing soil and water conservation practices that stabilize the land, reduce erosion, control sediment, improve and establish forest lands, manage runoff, abate pollution, and improve the environment. At one time these programs were discontinued but now have been reinstated. They were modified and updated.

The ASCS also is responsible for improving and stabilizing farm income in order to bring about a better balance between supply and demand of agricultural commodities, and for assisting farmers in marketing their products. Stabilization of farm incomes is achieved by making loans to eligible farmers for producing various agricultural crops. If market prices are good at the time of harvesting, the farmer repays the loan from his profits. If market prices are not good, the farmer repays the loan by forfeiting the crop which serves as collateral for the loan.

Water Bank Act Program

The Water Bank Program established under PL 91-559 and approved December 19, 1970, provides assistance to landowners to preserve, restore, and improve the wetlands of the nation. As the result of this assistance, the habitat of migratory waterfowl in important nesting and breeding areas will be set aside from encroachment by other land uses. The preservation of values associated with wetlands was also a part of the bill. This program is administered by the Agricultural Stabilization and Conservation Service with technical assistance in site qualification and farm planning provided by the Soil Conservation Service.

The bulk of the water bank program is located in the "pot hole" region of the northern United States which is the primary nesting grounds for waterfowl. Agricultural practices and other land use changes are constantly converting prime wetlands into wheat fields, pastures, or other developments. Leflore County, located in the basin, and one county each in Louisiana and Arkansas, were also selected to participate in the program.

Although most waterfowl species nest in the north, the wood duck is native to the south and utilizes hollows in trees in or near wetlands. Preserving wood duck nesting habitat, providing for preservation of other wildlife values, and providing wetlands for overwintering waterfowl use are primary benefits of the program in the basin.

Farmers whose land meets the requirements of the program must sign a contract agreeing not to drain the wetland or damage its wetland character for ten years. The land cannot be grazed nor can any timber harvest take place under present guidelines. As payment for these land use restrictions the participant is paid $5.00 per acre per year for all land accepted into the program.

In 1972, Leflore County farmers set aside 3,578 acres for preservation of water bank land. In 1974, 4,080 acres will be set aside to make a total of 7,658 acres in the county. More money is being requested by the ASCS County Committee because many people desiring to enter the program are left out when the allotted money is expended.

The total impacts of this program are far reaching. Wood ducks, alligators, squirrel, deer, turkey, rabbits, mallards, bobcats, and many other wildlife species are provided a stable habitat for ten years. The total environment of this county will be enhanced by the preservation of these wetland sanctuaries.

Farmers Home Administration

The Farmers Home Administration (FmHA) provides financial assistance to the rural sector of the nation. The primary objective of the FmHA is to improve the quality of rural living. Financial assistance includes loans for farm ownership, farm operations, rural housing, community water and waste disposal systems, and farm losses sustained by natural events.

Rural community water and waste disposal systems are closely related to water and related land resource development. As of January 1, 1975, 204 water and/or sewer system loans had been made in the basin. In addition, 15 recreation and 41 small watershed loans have been made. Of this number, 14 of the recreation loans were to non-profit organizations and one was to an RC&D project. Of the small watershed loans, five were for RC&D projects and 36 were for PL-566 or PL-534 type projects. These loans were made to defray the local costs to these groups for the various projects.

USDA Sedimentation Laboratory

The USDA Sedimentation Laboratory at Oxford, Mississippi, is the only facility in the United States dedicated solely to sedimentation research. Here, scientists of the U. S. Department of Agriculture, working in cooperation with the University of Mississippi and Mississippi State University, are studying erosion and sedimentation problems in the southern loess hills area of the Lower Mississippi Valley and in other parts of the United States.

Sedimentation includes the detachment, entrainment, transportation, and deposition of soil materials. The physical and chemical properties of sediment are also involved. Nearly all soils will erode when exposed to raindrop splash and flowing water. The resulting sediment creates many problems. Stream channels become clogged, above-normal flows spill over banks and create floods; navigation channels must be dredged; and reservoirs lose water-storage capacity.

Because of the enormous quantities of sediment eroded from the land each year, sediment has been labeled our greatest pollutant. Furthermore, sediment acts as a scavenger or carrier of other pollutants, releasing certain chemicals and absorbing others as it moves in the environment. This exchange may or may not be desirable, according to the situation.

Some of the projects, such as those dealing with erosion rates, watershed sediment yields, channel erosion, and reservoir and valley sedimentation, are long-term studies requiring many years for data collection and analyses. These studies are designed to provide information on erosion and sediment production from agricultural lands with widely varying soils, land use, and cover conditions; to evaluate old methods and develop new ones for estimating and controlling the delivery of sediment to downstream points; to provide reliable methods for estimating the amount and distribution of sediment deposits in reservoirs; and to provide information for the development and design of new and improved channel erosion control practices.

Other projects are concerned with the relationships between water flow in streams and bed material transport and the associated sand-bed irregularities. These studies are designed to provide information on (1) the capacities of stream channels for flood flows, (2) the inherent relationship of bed material transport and hydraulic slope which becomes extremely important in man-made channel changes, and (3) estimates of actual bed material transport and delivery to downstream points.

Projects dealing with the physical, mineralogical, and chemical properties of sediments are an important part of the laboratory's program. The properties of cohesive materials that retard or enhance erosion are not well defined. The role of sediment as a transporting vehicle for farm chemicals and other pollutants is extremely complicated. The adsorption and transport of farm chemicals by sediment particles and the complex association and transformations that occur in runoff water impoundments are not well understood. The enrichment of lakes and reservoirs with farm and nonfarm contaminants and the occurrence of rapid growths of algae and aquatic weeds alter the chemical environment of the ponded

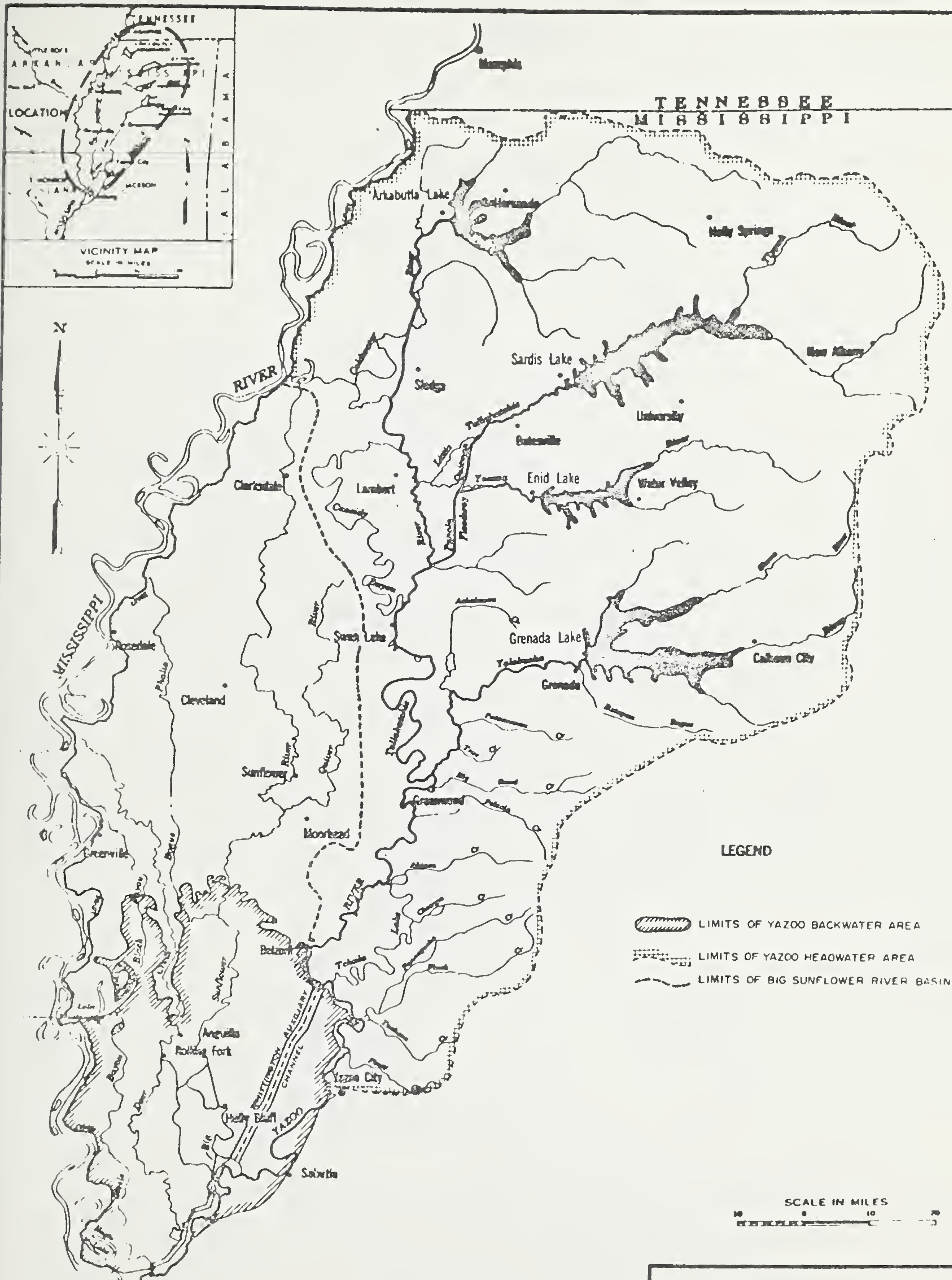
waters, often resulting in extremely undesirable conditions. While several of the laboratory's projects are designed to provide information on the contamination of streams and reservoirs, much additional work in this field is needed.

Corps of Engineers

The Corps of Engineers has done a vast amount of work in the basin starting with the construction of levees on the Mississippi River in 1928. The works of improvement are divided into four categories: the Mississippi River Levee System, the Yazoo Headwater area, the Yazoo Backwater area, and the Big Sunflower area (see map 6.3).

The Mississippi River Levee system begins just south of Memphis at the head of the Yazoo Basin and extends 270 miles to just above Vicksburg, Mississippi, where it connects to the Yazoo Backwater Levee. The levees were constructed by the Corps of Engineers and transferred to local interests for maintenance and operations.

Works of improvement on the Yazoo Headwater system includes channels and levees on the mainstream, four major reservoirs, local protection works for three cities, work on local tributary streams, an upper auxiliary channel and the Will M. Whittington Auxiliary Channel. Location of existing works and authorized works are shown on map 6.4. On the Yazoo River, extending from Vicksburg, Mississippi, to Greenwood, Mississippi, 160.2 miles of channel work and 107.7 miles of levee construction are complete. An additional 54.9 miles of levee remain to be constructed. Work on the Tallahatchie River includes 73.5 miles of completed channel improvements and 18 cutoffs. Future works consist of one channel cutoff and 30.4 miles of levee. The Coldwater River work includes 54.6 miles of channel improvement with 36 cutoffs and 32 miles of levees. Remaining work to be completed includes 40.0 miles of levees and 4.8 miles of channel construction on Bear Creek. The four major reservoirs are Arkabutla Lake on the Coldwater River, Enid Lake on Yocona River, Grenada Lake on the Yalobusha River, and Sardis Lake on the Tallahatchie River. These four reservoirs have a combined storage capacity of 3.8 million acre feet for flood control. In addition, they have a tremendous capacity for recreation and for fish and wildlife. Local protection works of improvement are for the cities of Greenwood, Belzoni, and Yazoo City and includes 27.2 miles of levees and headwalls, two cutoffs, and one pumping station. (Local tributary streams are those originating in the hills as well as those in the delta). Major streams include those below the four reservoirs, Cassidy Bayou, Big Sand Creek, Pelucia Creek, Tillatoba Creek, Hillside Floodway, Alligator-Catfish Bayous, and Whiteoak Bayou. To date, 244 miles of channel and 22 miles of levee are



YAZOO RIVER BASIN MISSISSIPPI

Map 6.3

GENERAL LOCATION MAP

U S ARMY ENGINEER DISTRICT VICKSBURG
CORPS OF ENGINEERS
VICKSBURG MISSISSIPPI
JUNE 1974

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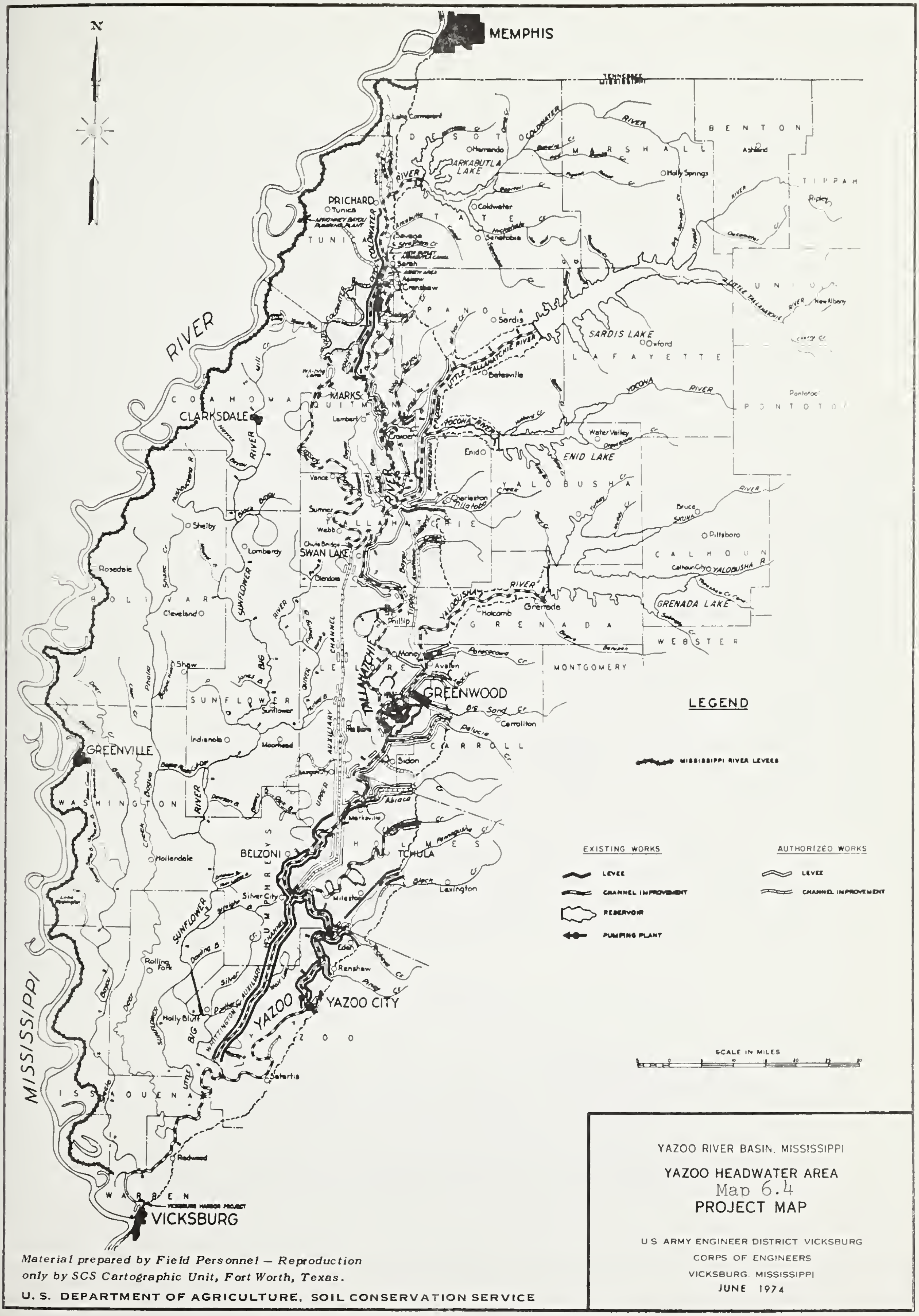
U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE



YAZOO RIVER BASIN, MISSISSIPPI

YAZOO HEADWATER AREA

Map 6.4

PROJECT MAP

U S ARMY ENGINEER DISTRICT VICKSBURG
CORPS OF ENGINEERS
VICKSBURG, MISSISSIPPI
JUNE 1974

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U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

completed. One pumping plant on McKinny Bayou has been constructed to pump water over the Mississippi River levee. Project works authorized but not completed are 215 miles of channel improvement and 137 miles of levee. The upper auxiliary channel is authorized but has not been completed. This channel, as authorized will take a substantial portion of the flood flow out of the Tallahatchie River and pass it down to the Yazoo River near the head of the Whittington auxiliary channel. The project includes a channel 63 miles long with 56 miles of parallel levees. Because of extensive local opposition to the authorized route, various alternative locations for the channel are being considered. The Will Whittington auxiliary is designed to take a major portion of the flood flow out of the Yazoo River near Silver City and pass it down to re-enter the river near the mouth of the Big Sunflower River. It is a new channel some 30.8 miles long with 61.3 miles of parallel levees and was completed in 1962.

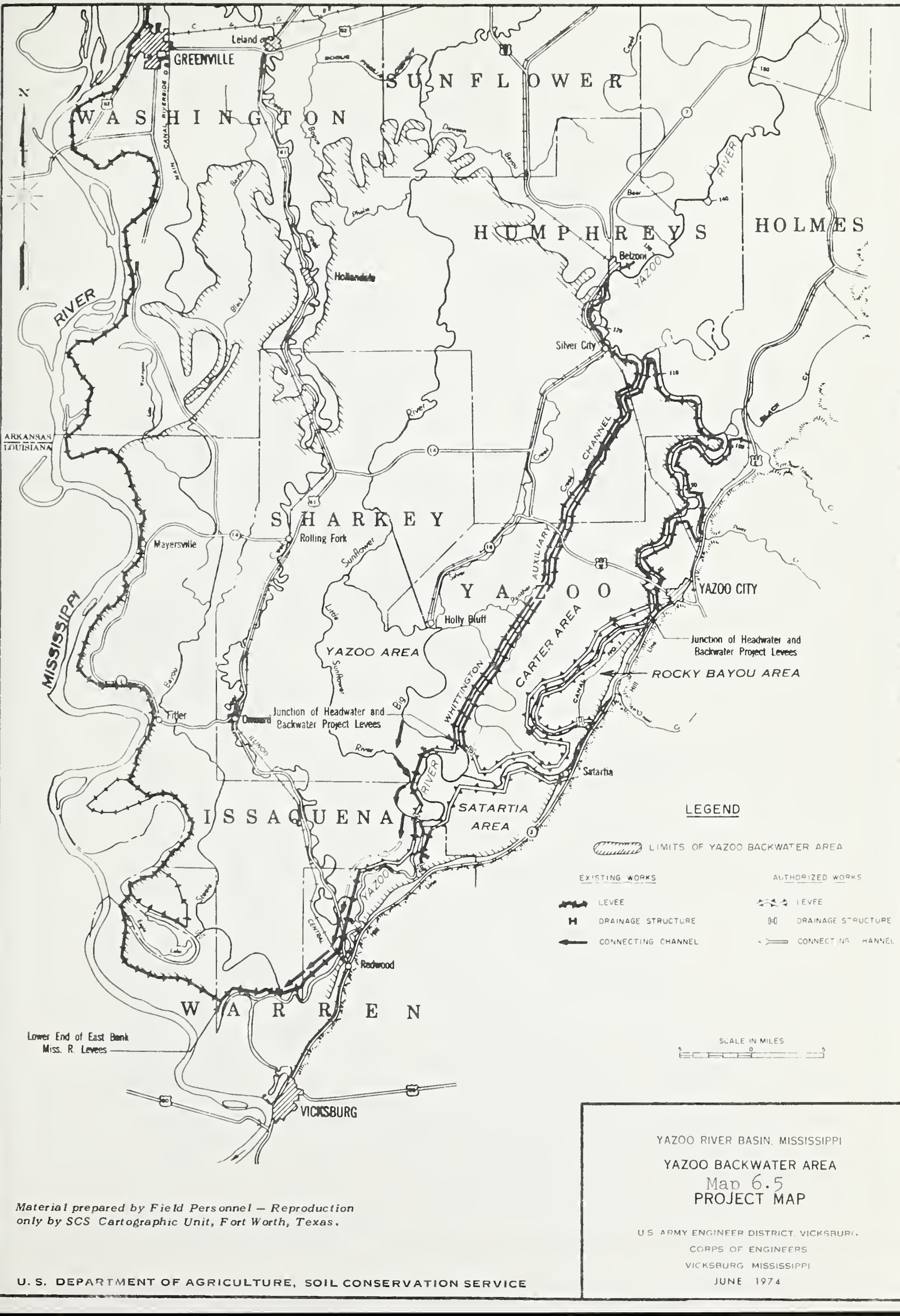
The Yazoo Backwater projects will provide protection to about 992 thousand acres of delta land in the lower end of the Yazoo Basin. Location of existing works and authorized works are shown on map 6.5. The construction includes 97.5 miles of levees, 39.9 miles of channel, several drainage structures, and a control structure in Muddy Bayou to permit control of water inflow into Eagle Lake. The works of improvement will provide protection to four separate sub-areas which are the Yazoo, Satartia, Carter, and Rocky Bayou. Approximately 30 percent of the works has been completed.

The Big Sunflower project when originally authorized provided for 592 miles of channel improvements on streams in the Sunflower Basin for flood control and drainage improvements on 2.6 million acres of alluvial lands (map 6.6). All of this work has been completed. Major streams included are Big Sunflower River, Little Sunflower River, Bogue Phalia, Quiver River, Hushpuckena River, Steele Bayou, Main Canal, and several other smaller streams. In 1965 Congress authorized further channel modifications on Steele Bayou and certain of its tributary streams and on Quiver River, and Gin and Muddy Bayous. Some 44.4 miles of this additional work has been completed with 18 miles remaining to be done.

Mississippi Board of Water Commissioners

The Mississippi Legislature, through Chapter 167 - General Laws of 1956, declared policy of the State in regard to the water resources of Mississippi. It provided for implementation of the basic policy with respect to beneficial uses of surface waters.

A separate Act of the 1956 Legislature, Chapter 46 (H.B. 1010) appropriated funds for a cooperative study of groundwater resources of Mississippi.



YAZOO RIVER BASIN, MISSISSIPPI

YAZOO BACKWATER AREA

Map 6.5

PROJECT MAP

U S ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
VICKSBURG MISSISSIPPI
JUNE 1974

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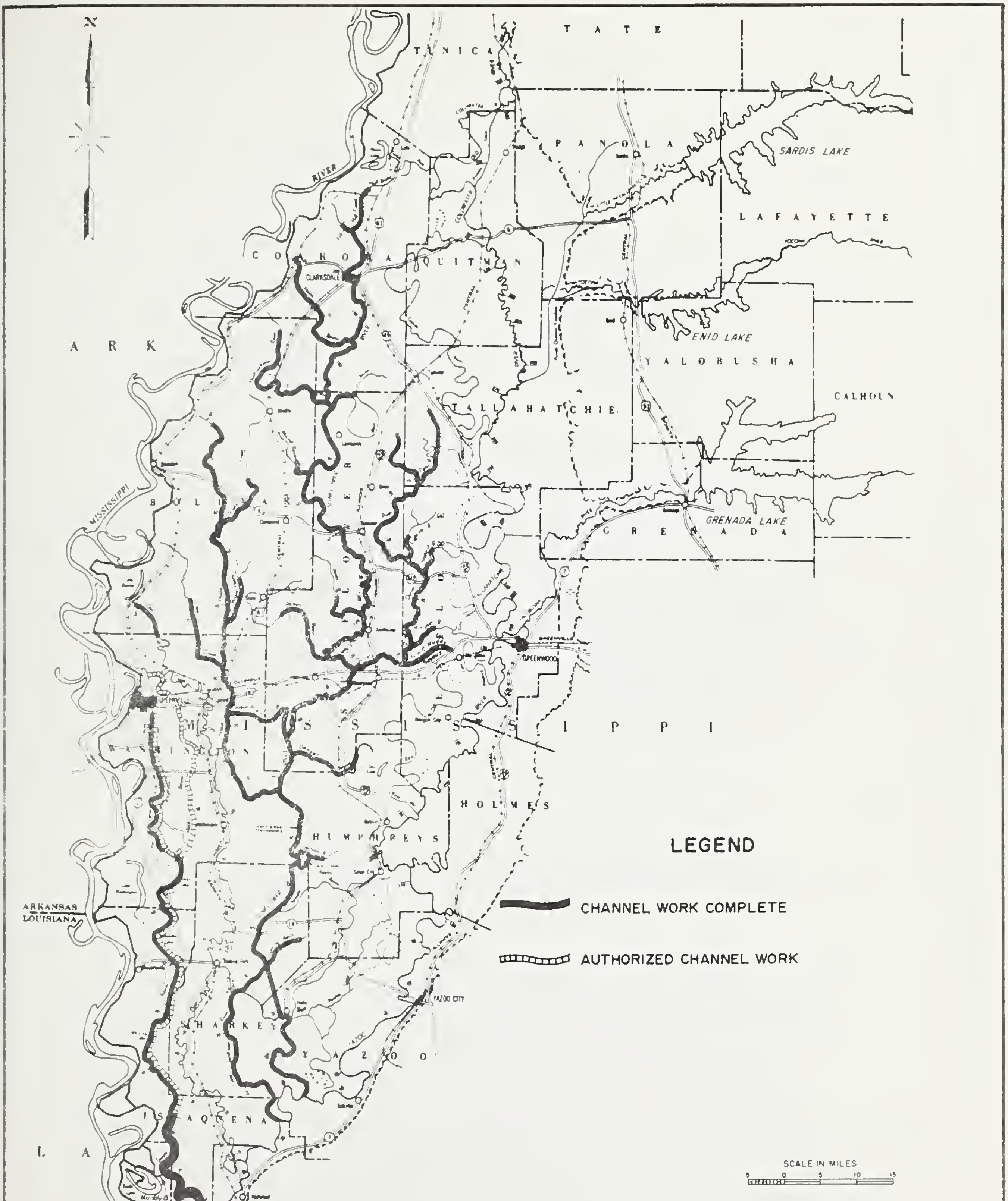

YAZOO RIVER BASIN, MISSISSIPPI

BIG SUNFLOWER RIVER BASIN

Map 6.6

PROJECT MAP

U.S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS
VICKSBURG, MISSISSIPPI
JUNE 1974

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Chapter 167 of House Bill 232 created the Mississippi Board of Water Commissioners to administer provisions of that Act. The Board has responsibility also for administering funds appropriated for the cooperative study of groundwater resources.

The Board of Water Commissioners is administered by seven members appointed by the Governor. The membership of the Board shall have represented on it at all times at least one member well versed in each major type of water user in the State as follows: recreational, industrial, municipal, and agricultural. There shall be one member appointed from each of the congressional districts and one from the state at large. The terms of office shall be for four years.

In brief, the Board of Water Commissioners is responsible for developing a general state water plan to protect existing water rights and control use of additional available water in the future. The Board administers the water rights law of the state and in this connection issues permits for appropriation of surface waters. It also supervises the operation of structures for irrigation, municipal and industrial water use, and approves formation of irrigation, reclamation, and water supply districts. In addition, the Board collects and correlates basic hydrologic data in cooperation with the United States Geological Survey in surface and ground water surveys. Also, the Board has complete arrangements to act as the coordinating agency for studies of land and water resources in Mississippi.

Planning and Development Districts

The State of Mississippi is divided into ten Planning and Development Districts. They were created by Executive Order Number 81 and signed by the Governor June 11, 1971.

Public Law 90-577, the Intergovernmental Cooperation Act of 1968, and Part IV of U.S. Office of Management and Budget Circular No. A-95, Revised, encourage the States "to exercise leadership in delineating and establishing a system of planning and development districts or regions in each state, which can provide a consistent geographic base for coordination of federal, state, and local development programs" in order to "minimize inconsistency among federal administrative and approval requirements placed on state, regional, and metropolitan development planning activities" and to "eliminate overlap, duplication, and competition in state and local planning activities assisted or required under federal programs and to encourage the most effective use of state and local resources available for development planning."

An increasing number of federal, state, and local assistance programs require a sub-state, multi-jurisdictional structure in order to preserve the eligibility of state and local governments to participate in certain federally-assisted programs and projects. The ten multi-county districts were organized with boundaries which represent natural, social, and economic relationships, and have proved to be effective in the planning, coordination, and administration of many public programs and projects.

The ten Planning and Development Districts are listed below. Seven Districts include one or more counties included in the Yazoo-Mississippi River Basin.

1. North Delta Planning and Development District - Coahoma, DeSoto, Panola, Quitman, Tallahatchie, Tate, and Tunica Counties.

2. South Delta Planning and Development District - Bolivar, Humphreys, Issaquena, Sharkey, Sunflower, and Washington Counties.

3. North Central Mississippi Planning and Development District - Attala, Carroll, Grenada, Holmes, Leflore, Montgomery, and Yalobusha Counties.

4. Golden Triangle Planning and Development District - Choctaw, Clay, Lowndes, Noxubee, Oktibbeha, Webster, and Winston Counties.

5. Three Rivers Planning and Development District - Calhoun, Chickasaw, Itawamba, Lafayette, Lee, Monroe, Pontotoc, and Union Counties.

6. Northeast Mississippi Planning and Development District - Alcorn, Benton, Marshall, Prentiss, Tippah, and Tishomingo Counties.

7. Central Mississippi Planning and Development District - Copiah, Hinds, Madison, Rankin, Simpson, Warren, and Yazoo Counties.

8. East Central Mississippi Planning and Development District - Clarke, Jasper, Kemper, Lauderdale, Leake, Neshoba, Newton, Scott, and Smith Counties.

9. Southern Mississippi Planning and Development District - Covington, Forrest, George, Greene, Hancock, Harrison, Jackson, Jefferson Davis, Jones, Lamar, Marion, Pearl River, Perry, Stone, and Wayne Counties.

10. Southwest Mississippi Planning and Development District - Adams, Amite, Claiborne, Franklin, Jefferson, Lawrence, Lincoln, Pike, Walthall, and Wilkinson Counties.

Soil Conservation Districts

The more than 3,000 soil conservation districts throughout the nation have provided both educational programs and technical services to about 1.7 million district cooperators. About three-fourths of these cooperators own forest land. The Soil Conservation Service, Extension Service, Forest Service, State Forestry Departments, and other agencies work through the districts in applying conservation planning and conservation programs to private farm and forest lands. Most conservation districts have committees dealing with forestry problems at state and local levels.

The educational programs of the districts, relating to forestry and the small non-industrial forest landowners, are for the most part, carried on as a part of the district's on-going educational program in resource conservation and management. Intensified programs have been conducted by districts in the examples of the "Third Forest", the Tennessee Valley Authority program, and others.

An important aspect of the Soil Conservation District Program is in the area of providing services to the small, non-industrial forest landowner. In some areas, this service, in the form of site preparation, planting, and timber stand improvement is available only through the districts. In other districts they are the primary source of service.

Mississippi Game and Fish Commission

The Mississippi Game and Fish Commission is charged with the overall responsibility of the state game and fish resource. Law enforcement, management of fish and game populations on state and private areas, and research are vital functions of the Commission program.

All counties have conservation officers that provide basic law enforcement leadership. These officers also assist in other duties relating to management, public relations, and research.

Assistance to private landowners and hunting clubs in the management of game and fish populations is every day work for Commission biologists and technicians. In addition to private holdings, the Commission manages wildlife areas and provides assistance to state-owned lakes.

Basic research on waterfowl, deer, turkey, dove, and insecticide problems associated with fish and game is carried on by Commission research biologists. Waterfowl areas managed by the Commission on the Corps reservoirs are used for Canada goose research, banding of

waterfowl, and wood duck nesting box studies. Statewide hunter participation and harvest data are compiled and produced for use in overall management of wildlife and fish populations.

Special studies are being conducted on the insecticide pollution problems associated with delta lakes. Monitoring of pesticide levels in selected delta lakes is conducted by fishery biologists as well as management and restocking programs on ponds and lakes.

Mississippi Park Commission

The Mississippi Park Commission presently administers five state parks and one historical site within the basin. The historical site and one state park are located in the delta and the remainder are in the uplands.

The historical site (Winterville Mounds) is a major tourist attraction as well as being educational to local students.

The state parks provide picnicking, camping, swimming, fishing, boating, hiking, and other recreation benefits to basin residents. These facilities are some of the most modern in the basin and receive the majority of the recreation use.

Extension Service

The Cooperative Extension Service System serves as the educational agency of the Department of Agriculture. The name "Cooperative Extension" is derived from financial and administrative arrangements involving three levels of government - federal, state, and county.

Extension forestry and related natural resource educational programs (wildlife, fisheries, recreation, water, and forage) are directed toward the stimulation, motivation, and education of forest owners to do a more efficient job of managing their privately-owned forest lands. Briefly, this is done through continuing educational programs, mass media, and on occasion, on an individual basis. The role of the extension forester, in most cases, is that of a stimulator, an awareness creator, and an agent of change, facilitating the objectives of other technical programs that may be provided by federal, state, and private agencies.

Mississippi Forestry Commission

The Mississippi Forestry Commission is assigned many responsibilities by laws enacted in the legislature designed to help all

Mississippians enjoy a better life through more productive forests and industries. Some of these are:

I. Fire Protection

A. To prevent forest fires.

B. To extinguish wildfires as swiftly as possible so that damage can be held to a minimum.

C. To enforce any and all laws pertaining to the protection of forests.

II. Forest Management

A. To assist landowners with forest management problems.

B. To encourage better forest management.

C. To manage public forest lands belonging to the state.

D. To grow tree seedlings and encourage tree planting on idle and currently unproductive land.

III. Insect and Disease Control

A. To conduct systematic surveys.

B. To advise landowners on insect and disease problems in their forests.

C. To assist landowners during insect and disease epidemics.

D. To promote good forest management; a key to insect and disease prevention.

IV. Information and Education

A. To keep the public aware of Commission services and activities.

B. To work in the schools; teaching, and demonstrating forest conservation and protection.

C. To keep the public aware of the value of our forest to all citizens.

In an effort to serve the landowner and yet, not compete with consulting foresters and private vendors, the Commission puts limitations on the amount of services to a given landowner.

Delta Council

The Delta Council is an organization of farmers, business and professional people, industrialists, and other residents of the area. It was organized in 1935 for the promotion of the economic and well-being of the people of the area through economic and resource development. It covers the 18 delta and part-delta counties of northwest Mississippi. The Council has many areas of interest in development of the delta - one of the most important of which is the conservation, utilization, and development of its land and water resources.

It is the policy of the Delta Council that the conservation, development, and efficient utilization of soil and water resources is of paramount importance to the ultimate development of the Yazoo-Mississippi River Basin, the state, and the nation.

CHAPTER VII

ALTERNATIVE SOLUTIONS

General

One of the preliminary steps in formulating water and related land resource plans and programs was to identify a range of solutions to the basin's water and related land resource problems and needs. Alternative solutions were then investigated to the degree necessary to make a reasonable decision on their practicability, based on available information and informed judgment. Accordingly, some alternatives received only superficial consideration, whereas others were investigated in depth.

The water and related land resource needs of the Yazoo-Mississippi River Basin may be met by a variety of methods, including single and multiple-purpose structures and nonstructural measures. Consideration of the various alternatives provided an insight into resource availability and capability and formed a basis for formulating a plan which will serve as a guide for the best use of the water and related land resources.

For each major problem, practical solutions were weighed and tested for applicability, effectiveness, and relative economy. The following paragraphs discuss the solutions and alternatives considered.

Water Supply

Water requirements were developed and projected on the basis of population and industrial growth and the estimated increases in per capita usage of water. An inventory of existing supplies was made and deducted from the requirements to obtain net needs. From an overall basin-wide standpoint, existing supplies are in excess of those needed to meet requirements for some time in the future. No major problems of water supply deficiencies are envisioned so long as the existing resources are managed properly. Major options available as possible solutions to water supply problems, if and when they occur, are presented in table 7.1.

Land

High priority land uses determine the character and appearance of the land resource. The admixture of these uses therefore can provide an important clue as to what the physical appearance of the basin will be in future years. Primary land uses include urban and built-up, cropland, pasture, other, and forestland. They also include recreation areas

Table 7.1. Potential solutions to water withdrawals problems and needs, Yazoo-Mississippi River Basin

Withdrawals	Potential solutions 1/
Municipal	Surface water development 2/
Industrial	Additional surface storage
Rural domestic	Ground water development
Thermal	Water salvage
Irrigation	Ground water recharge
Livestock	Inter-basin diversion
Minerals	Water conservation 3/
Fish and wildlife	
Commercial fishing	

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Applicable to one or more needs.

2/ Development of existing surface waters without additional storage.

3/ Reduced water use through metering and pricing, development control, rationing, public education, facilities repair or replacement, elimination of wasteful uses, evaporation reduction, and increasing irrigation efficiency and cropping so as to reduce water requirements for a given level of production.

and fish and wildlife management areas, and natural environmental quality components. These components include unique ecological and geological systems, and wilderness areas, among others.

Many of the land uses or needs are overlapping, as in the case of cropland and pasture providing wildlife food and cover. Potential solutions to land needs are presented in table 7.2.

Alternative solutions for meeting land needs form the basis for land resource plans. Several alternative rates of development were considered and three were selected for study. These alternatives are:

(1) Baseline water and related land use.

(2) Without further water and related land resource development.

(3) With accelerated water and related land resource development.

Table 7.2. Potential solutions to land problems and needs, Yazoo-Mississippi River Basin

Land	Potential solutions 1/
Cropland	Conversion of land use
Pasture	Purchase
Forest	Easements
Other agriculture	Land-use regulation
Urban and built-up	Subsidy
Recreation	Purchase and re-sell
Commercial fish farming	Facility development
Fish and wildlife	Access development
Minerals	
Environmental	

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Potential solutions may apply to one or more needs.

Baseline Water and Related Land Use

This baseline is based on the Series C OBERS projections which assumes that past rates of water and related land resource development will continue to occur. Average state crop yields were used to determine the share of the total national demand for agricultural products that are projected to accrue from the basin. These OBERS allocations apply to crops, livestock, and wood products.

Baseline projections for land needs other than food and fiber are based on projected population and other relevant parameters. Baseline water and related land use is presented in table 7.3.

Cropland - The acres of cropland for this alternative are presented in table 7.3. The acreage in each time frame will meet basin food and fiber requirements as displayed in table 3.6, Chapter III. However, forest acreage necessary to sustain the supply of wood products cannot be met. Some pressure also will be exerted on pasture land.

Pasture - Average state production rates were used in determining pasture land needs. It was assumed that a portion of the forage requirements will be supplied from grazed cropland and forestland. The projected acreages are regarded as conservative. Unless good pasture management practices are adopted, the acreage displayed will not meet the needs of the expanding livestock industry.

Table 7.3. Baseline water and related land use, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Land use	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Cropland	3,640,000	4,128,300	4,482,000	4,377,000
Harvested	2,970,000	3,592,300 1/	4,132,000 1/	4,102,000 1/
Pastured	326,000	320,000	200,000	175,000
Idle	344,000	216,000	150,000	100,000
Pasture	943,000	1,330,600	1,018,900	1,205,900
Forest	3,222,000	2,279,000	2,165,000	2,045,000
Other	291,000	253,000	230,000	163,000
Urban	258,000	335,000	361,000	426,000
Small water	103,000	119,100	119,100	119,100
Large water	90,000	102,000	171,000	211,000
Total area	8.547.000	8,547,000	8,547,000	8,547,000

Source: Formulated by River Basin Survey Staff, United States Department of Agriculture.

1/ Based on OBERS crop yields for Mississippi.

Forest - As previously mentioned, the forestland acreage is less than that required to meet wood product needs in the years 2000 and 2020. In 1980, 133 percent of the needs are met. In the year 2000, only 95 percent of the needs are met and only 82 percent in 2020. Demand could be met by cutting into the growing stock but the long term effect would be the destruction of the resource base.

Other Lands - This alternative provides ample land to meet this land use. The acreages are consistent with long term trends for this land use category.

Urban and Built-up - All land needs are met under this alternative. Ample provisions were considered in providing necessary land for an expanding basin population.

Recreation Land - Land used for recreation is not specifically identified but is included in land categories such as forest, other, and urban and built-up. Land used for recreation currently amounts to about 26 thousand acres. Recreation developments on this land are primarily for swimming, camping, picnicking, and golfing. Based on present demand for these and other outdoor pursuits, approximately 121 thousand acres of land are needed. Major unmet needs are for play fields, tennis courts, and trails.

Future needs for high density recreation facilities will be met. These include swimming pools, play fields, and tennis courts. All of the future needs for low density use such as bike trails, nature trails, hiking trails, and 18-hole golf courses probably will not be met. Large land acquisition costs and land ownership patterns that do not lend themselves to development are the primary reasons.

The Mississippi Statewide Outdoor Recreation Plan beginning in 1972 provides for the following: (1) further development of Arkabutla Reservoir, Sardis Reservoir, and John W. Kyle State Park; (2) further development of Chewalla Lake in Marshall County; (3) expansion of facilities at Leroy Percy State Park in Washington County; (4) further development of Hugh White Park, Carver Point State Park, and Grenada Reservoir in Grenada County; (5) development of Yocana Ridge State Park in Yalobusha County; and (6) development of Enid Reservoir.

Wildlife Lands - Present wildlife habitat comprises approximately 8.0 million acres of land. The habitat includes cropland, pasture, forest, and other lands. Hunter demand translated into land indicates a need for 8.0 million acres in 1980, 9.0 million acres in 2000, and 11.0 million acres in 2020. Huntable land will meet 100 percent of the needs in 1980, 88 percent in 2000, and 71 percent in 2020.

Natural Areas - The problems and needs concerning the environment are discussed in Chapter IV. The major components include 11.7 thousand

acres in ten ecological systems, 1.1 thousand acres in a natural geological system, 5.0 thousand acres of wilderness area, 201 thousand acres of bottomland hardwoods, 8.0 thousand acres of open and green space, and 1.8 thousand acres of shore line around 21 natural lakes. To meet these needs under this alternative would be at the expense of wood products on about 229 thousand acres of hardwood forest.

This alternative recognizes these needs but no provisions are made to reserve these components during the time frame of the study.

Without Further Water and Related Land Resource Development

This alternative is based on no further federally funded land resource development after 1970 but assumes some additional private development will occur through normal economic incentives. It was assumed that no beneficial effects would accrue to the agricultural production sector of the agricultural economy from agricultural drainage, flood damage reduction, or land treatment practices over and beyond that now afforded. However, it was assumed that the present level of resource development will be maintained in future years.

Production requirements (crops, livestock, and wood products) are the same as those for the baseline alternative (see table 3.6, Chapter III). The land and water allocations are presented in table 7.4.

Cropland - Needs are based on meeting baseline food and fiber requirements with less than maximum crop yields. This alternative will require 4.1 million acres of cropland in 1980, 4.5 million acres in 2000, and 4.4 million acres in 2020.

Food and fiber requirements can be met but at the expense of forestland. Less pressure would be exerted on pastureland in the years 2000 and 2020.

The present (1970) cropland base is inadequate in terms of available soils in Classes I through IV to provide for this expansion. Therefore to meet the needs, land use conversions are projected to occur.

Pasture - Like cropland, land used for livestock production assumes a less efficient use of the land. However, this alternative will meet 100 percent of the livestock production requirements. Projected acreages are 1.2 million acres in 1980, 1.3 million acres in 2000, and 1.5 million acres in 2020.

Forest - Treated as a residual, forestland would decline to 2.4 million acres in 1980, to 2.0 million acres in 2000, and 1.9 million acres in 2020. By holding forest production constant at the 1970 production levels, projected acreage will meet 123 percent of needs in 1980,

Table 7.4. Land use without further water and related land resource development, Yazoo-Mississippi River Basin, 1970 and projected 1980, 2000, and 2020

Land use	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Cropland	3,640,000	4,148,700	4,483,100	4,399,500
Harvested	2,970,000	3,612,700	4,133,100	4,124,500
Pastured	326,000	320,000	200,000	175,000
Idle	344,000	216,000	150,000	100,000
Pasture	943,000	1,200,000	1,300,000	1,500,000
Forest	3,222,000	2,417,300	1,979,900	1,865,500
Other	291,000	253,000	230,000	163,000
Urban	258,000	335,000	361,000	426,000
Small water	103,000	103,000	103,000	103,000
Large water	90,000	90,000	90,000	90,000
Total area	8,547,000	8,547,000	8,547,000	8,547,000

Source: Formulated by River Basin Survey Staff, United States Department of Agriculture.

74 percent in 2000, and 59 percent in 2020. As under the baseline alternative, 100 percent of needs can be met by cutting into the growing stock; however, the impacts would be more drastic.

Other Land - This alternative will meet 100 percent of the needs as described in the baseline alternative and displayed in table 7.4.

Urban and Built-up - This alternative will provide for 100 percent of the land required for the projected population.

Recreation Land - It is assumed that public developments will remain at the 1970 level. Private development is assumed to continue at about the same rate as in previous years. This alternative will meet most recreation needs with the exception of hiking trails, bicycle trails, horse trails, and outdoor playing fields.

Wildlife Lands - The amount of huntable land will remain about the same as the baseline acreage. There will be a decline in the amount of suitable habitat for forest game species such as deer, turkey, and squirrel. Hunting pressure will be adjusted toward greater utilization of game species that are adaptable to cropland, pasture, and other lands.

Natural Areas - Only the environmental components maintained in public ownership as of 1970 will be met. These components include 5 thousand acres of near wilderness or natural areas, and 54 thousand acres of bottomland hardwoods. While other components may continue to exist, no provisions are made to reserve them for future generations.

With Accelerated Water and Related Land Resource Development

This alternative represents a continuation of the historical rate of adoption of new technology, better management, and accelerated resource development. Therefore, it includes the beneficial effects of agricultural drainage, flood damage reduction, streambank stabilization, and land treatment practices.

Production requirements (crops, livestock, and wood products) are the same as the other two alternatives previously presented (see table 3.6, Chapter III). The land and water allocations are presented in table 7.5.

Cropland - Needs are based on meeting baseline food and fiber requirements with high sustained crop yields, high levels of management, and resource development. This alternative will require 3.2 million acres of harvested cropland in 1980, 3.3 million acres in 2000, and 3.4 million acres in 2020. The projected acreages are within the available supply of soils in Classes I through IV and 100 percent of the crop production requirements can be met.

Table 7.5. Land use with accelerated water and related land resource development, Yazoo-Mississippi River Basin, 1970 and projected 1980. 2000, and 2020

Land use	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Cropland	3,640,000	3,751,000	3,638,500	3,642,700
Harvested	2,970,000	3,215,000	3,288,500	3,367,700
Pastured	326,000	320,000	200,000	175,000
Idle	344,000	216,000	150,000	100,000
Pasture	943,000	1,377,700	1,449,200	1,450,500
Forest	3,222,000	2,609,200	2,578,400	2,534,700
Other	291,000	253,000	230,000	163,000
Urban	258,000	335,000	361,000	426,000
Small water	103,000	119,100	119,100	119,100
Large water	90,000	102,000	171,000	211,000
Total area	8,547,000	8,547,000	8,547,000	8,547,000

Source: Formulated by River Basin Survey Staff, United States Department of Agriculture.

Pasture - Compared to the baseline alternative, additional land is available for production of livestock products. The acreages in each time frame should sustain the projected increase in livestock production.

In addition to land devoted to permanent pasture, additional grazing is available from pastured cropland and forestland. Less grazing pressure is exerted on pasture land for this alternative than on pasture land in the other two alternatives.

Forest - This alternative assumes a 12 percent acceleration of wood product production above the baseline. Projected acreages of forestland are 2.6 million acres in 1980, 2.6 million acres in 2000, and 2.5 million acres in 2020. These acreages are in excess of those presented in table 4.24 and therefore are ample to supply 100 percent of the wood products. The needs can be met by cutting only the annual growth and assures a continuing supply for future generations.

Other Land - This use of land is a recognized component of the land base. Under this alternative, 100 percent of the demands placed on this category can be met.

Urban and Built-up - This alternative meets all the projected needs for this land category. Adequate land is provided for the development of recreational facilities normally associated with urban interests.

Recreation Land - Sufficient land is available to meet developing needs. A large portion of land used for recreation is multi-use with other primary land use categories.

Wildlife Lands - This alternative maintains about the same amount of huntable land as the baseline and no development alternatives. However, the type and mixture of wildlife habitat is more productive. Since some game species are primarily dependent on forestland habitat, this alternate favors deer, turkey, and squirrel.

Sufficient land is not available in the basin to meet all hunting demands through the year 2020. There is an estimated deficit supply of 1.1 million acres in 2000 and 3.2 million acres in 2020.

Natural Areas - This alternative meets all the recognized needs for specified environmental components as described in the baseline alternative. There is sufficient land and water space to meet all of the recreation needs within the basin by 2020. This land should be selected and reserved for future development under an early action program.

Flood Damage Reduction

Potential solutions to controlling flood damages are presented in table 7.6. All listed alternatives for flood damage reduction were considered appropriate and were retained for possible application in specific locations throughout the basin. Zoning, regulation, flood proofing, and flood warning were not viewed as viable alternatives for reducing agricultural (crop and pasture) flood damages. They were, however, viewed as appropriate and viable measures for mitigating urban damages, wherever such damages occur in the basin.

Flood damages as outlined previously exist in both the upland (bluff and hills) and delta subareas of the basin. To reduce these damages, alternative flood prevention projects were evaluated for these two principal areas.

The upland (bluff and hills) area presently has flood prevention projects being installed under the PL-534 program. These existing projects, discussed in Chapter VI, include about 70 percent of the upland area. However, all project measures are not installed and even with complete installation damages still remain. To study the effects of the installed measures and the effects of additional measures, three evaluations each consisting of different structural measures for reducing flood damages were made. A discussion of each of these evaluations and the effects on damage reduction follows.

Table 7.6. Potential solutions to flood damages, Yazoo-Mississippi River Basin

Item	Potential solutions
Flood damage	Reservoir storage
	Channelization
	Levees and floodwalls
	Pumping plants
	Channel stabilization
	Zoning and regulation
	Warning and evacuation
	Flood proofing
	Watershed land treatment
	Diversion of flood flows
	Flood insurance

Source: River Basin Survey Staff, United States Department of Agriculture.

Evaluation number one consists of an analysis of the structural measures that have been installed by the date June 1973. These structural measures include 294 floodwater retarding dams that control 11 percent of the area and 519 miles of channel work. Total installation costs amount to $26.1 million. Total annual damages are reduced by 33 percent. However, remaining annual damages total $9.0 million. Table 7.7 presents additional data by areas as well as for the entire upland area.

Evaluation number two is an analysis of all planned and installed measures as of the date June 1973. When the 437 floodwater retarding dams and the 982 miles of channel work that have been planned are completely installed, annual damages will be reduced by 50 percent. Annual damages remaining total $6.8 million. The benefit-cost ratio is 2.15 to 1. Table 7.8 presents additional data for this evaluation.

Evaluation number three consists of an analysis of all of the presently installed floodwater retarding dams and channel work plus additional floodwater retarding dams. Total structural measures include 758 floodwater retarding dams that control 36 percent of the area and 519 miles of channel work. Total installation costs amount to $87.2 million. Total annual damages are reduced by 60 percent, but $5.4 million annual damages remain after installation is complete. The benefit-cost ratio is 1.55 to 1. Table 7.9 presents additional data for this evaluation.

The delta (alluvium) area also has projects installed or being installed under the PL-566 and PL-534 programs. These existing upstream projects are discussed in Chapter VI. Generally, these are channel projects that improve the management of these rich soils. Flooding problems exist throughout the delta and damages are high. Channel sizes have to be based on the adequacy of the outlet among other items. To study the effects that channel sizes have on damage reduction and to have data for making recommendations, three alternative flood damage reduction projects were evaluated. All channel sizes were based on the formula Q = CM5/6 where C is a coefficient, M is drainage area in square miles, and Q is the required design flow. These evaluations - 40M5/6, 55M5/6, and 70M5/6 - are discussed below.

The alternative 40M5/6 consisted of a study of 5,191 miles of upstream channels to determine the adequacy of these channels. The evaluation showed that 4,037 miles of the 5,191 miles required channel work to provide this size channel in all areas. The total cost of installing the channels amounts to $57.3 million. Annual benefits total $13.0 million. However, remaining annual damages are $13.2 million. The benefit-cost ratio is 2.5 to 1.0. Table 7.10 provides additional data for this alternative.

Table 7.7. Evaluation number one,[1/] structure data, costs, damages and benefits by subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea 9	Subarea 10, 12, 13	Subarea 11	Total
Floodwater retarding structures					
Installed	Number	155	56	83	294
Area controlled	Acres	284,889	54,499	121,989	461,377
Area controlled	Percent	19	3	13	11
Channel development					
Installed	Miles	17	303	199	519
Total installation costs					
Retarding structures	Dollars	10,276,717	2,711,227	4,480,067	17,468,011
Channels	Dollars	93,257	5,557,123	2,943,477	8,593,857
Total	Dollars	10,369,974	8,268,350	7,423,544	26,061,868
Annual damages					
Present without project	Dollars	5,277,735	5,515,370	2,680,763	13,473,868
Reduction with project	Percent	39	25	37	33
Remaining	Dollars	3,207,335	4,115,647	1,690,550	9,013,532

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes all structural measures installed to date, June 1973.

Table 7.8. Evaluation number two,[1] structure data, costs, damages, and benefits by subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea			
		9	10, 12, 13	11	Total
Floodwater retarding structures					
Installed	Number	155	56	83	294
Remaining to be installed	Number	66	43	34	143
Total	Number	221	99	117	437
Area controlled	Acres	409,782	124,753	150,136	684,671
Area controlled	Percent	27	7	16	16
Channel development					
Installed	Miles	17	303	199	519
Remaining to be installed	Miles	84	258	121	463
Total	Miles	101	561	320	982
Total installation cost					
Retarding structures	Dollars	17,549,613	6,878,170	6,963,712	31,391,495
Channels	Dollars	1,156,358	10,846,465	5,085,412	17,088,235
Total	Dollars	18,705,971	17,724,635	12,049,124	48,479,730
Annual damages					
Present without project	Dollars	5,277,735	5,515,370	2,680,763	13,473,868
Reduction with project	Percent	53	42	60	50
Remaining	Dollars	2,471,044	3,201,689	1,081,322	6,754,055
Annual cost	Dollars	1,374,864	1,367,511	911,072	3,653,387
Annual benefits	Dollars	3,253,885	2,792,097	1,820,149	7,866,131
Benefits - Cost	Ratio	2.42:1.0	2.04:1.0	2.00:1.0	2.15:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes all structural measures planned and installed to date, June 1973.

Table 7.9. Evaluation number three,[1/] structure data, costs, damages, and benefits by subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea 9	Subarea 10, 12, 13	Subarea 11	Total
Floodwater retarding structures					
Installed	Number	155	56	83	294
Remaining to be installed	Number	181	187	96	464
Total	Number	336	243	179	758
Area controlled	Acres	704,223	534,380	296,007	1,534,610
Area controlled	Percent	47	29	32	36
Channel development					
Installed	Miles	17	303	199	519
Remaining to be installed	Miles	--	--	--	--
Total	Miles	17	303	199	519
Total installation cost					
Retarding structures	Dollars	35,307,396	27,375,170	15,472,573	78,155,139
Channels	Dollars	93,257	6,015,054	2,943,477	9,051,788
Total	Dollars	35,400,653	33,390,224	18,416,050	87,206,927
Annual damages					
Present without project	Dollars	5,277,735	5,515,370	2,680,763	13,473,868
Reduction with project	Percent	65	56	58	60
Remaining	Dollars	1,840,566	2,427,906	1,131,906	5,400,378
Annual cost	Dollars	2,578,529	2,476,848	1,354,122	6,409,499
Annual benefits	Dollars	4,159,244	3,858,045	1,897,595	9,914,884
Benefits - cost	Ratio	1.61:1.0	1.56:1.0	1.40:1.0	1.55:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes all structural measures installed plus additional floodwater retarding structures.

Table 7.10. Channel development alternatives - structural measures, annual costs, annual benefits, and benefit-cost ratio by subareas, delta part of the Yazoo-Mississippi River Basin

Item	Channels		Total cost of:	Damages		Annual		
	Studied	Needing improvement	structural measures	Before project	Remaining	Costs	Benefits	Benefit Cost Ratio
	Miles	Miles	Thousand dollars					
Alternative 40M5/6								
Areas 1, 2, 3, 4, 5, 6, 7, 8W (566)	4,225	3,172	43,714.9	19,270.7	11,380.1	3,849.9	9,098.3	2.4:1.0
Area 8E (534)	966	865	13,624.8	5,313.4	1,837.1	1,279.3	3,945.2	3.1:1.0
Total	5,191	4,037	57,339.7	24,584.1	13,217.2	5,129.2	13,043.5	2.5:1.0
Alternative 55M5/6								
Areas 1, 2, 3, 4, 5, 6, 7, 8W (566)	4,225	3,854	63,667.1	19,270.7	7,773.7	5,459.5	13,239.8	2.4:1.0
Area 8E (534)	966	880	17,374.9	5,313.4	1,100.9	1,597.5	4,782.4	3.0:1.0
Total	5,191	4,734	81,042.0	24,584.1	8,874.6	7,057.0	18,022.2	2.6:1.0
Alternative 70M5/6								
Areas 1, 2, 3, 4, 5, 6, 7, 8W (566)	4,225	4,015	83,085.8	19,270.7	5,974.0	6,950.7	15,379.7	2.2:1.0
Area 8E (534)	966	887	19,934.5	5,313.4	854.3	1,893.7	5,083.5	2.7:1.0
Total	5,191	4,902	103,020.3	24,584.1	6,828.3	8,844.4	20,463.2	2.3:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

The alternative 55M5/6 also was a study of the same 5,191 miles of proposed project channels to determine their adequacy. Of the 5,191 miles, 4,734 miles required channel work to provide the 55M5/6 capacity. Total cost of installing the channels amounts to $81.0 million. Annual benefits total $18.0 million. The benefit-cost ratio is 2.6 to 1.0. In addition, remaining damages total $8.9 million. Table 7.10 presents additional data for this alternative.

The third alternative, 70M5/6, resulted in 4,902 miles of the 5,191 miles of project channels studied requiring channel work. Total installation costs amount to $103.0 million. Total annual benefits are $20.5 million. The resulting benefit-cost ratio is 2.3 to 1.0. When this size channel is installed, remaining annual damage will be $6.8 million. Also, table 7.10 presents additional data for this alternative.

Additional data showing some effects of the three alternatives studied in the delta area of the basin are presented in tables 7.11 and 7.12. Table 7.11 shows that 1.5 million acres flood under present conditions with these acres being reduced to 1.4 million acres for the 40M5/6 alternative, to 1.3 million acres for the 55M5/6 alternative, and to 1.2 million acres for the 70M5/6 alternative. Table 7.12 shows the required channel capacities for various drainage areas and the three alternative sizes as well as 24-hour water removal rates for the same drainage areas and alternatives.

Although the reduction in acres flooded is not very great, the larger size channels will remove a larger volume of water per day as shown for the various drainage areas. Using the design with the largest coefficient, the water will not remain on the ground as long and hence the duration of flooding is shortened.

Table 7.11. Land subject to flooding in the upstream delta watersheds presently and with three channel development alternatives, Yazoo-Mississippi River Basin

Subarea	Present area flooded	Channel development alternatives		
		40M5/6	55M5/6	70M5/6
	Acres	Acres	Acres	Acres
1	170,857	159,551	149,271	138,860
2	349,253	322,458	302,562	281,451
3	114,424	107,727	100,705	93,243
4	50,594	47,033	44,292	41,369
5	157,551	150,915	140,370	131,076
6	82,082	78,121	73,934	68,843
7	23,671	21,721	20,453	19,255
8	559,664	521,202	494,146	467,653
Total	1,508,096	1,408,828	1,325,733	1,241,750

Source: Soil Conservation Service, United States Department of Agriculture.

Table 7.12. Required channel capacities and watershed inches of water removed each 24 hours for the channel development alternatives in the delta, Yazoo-Mississippi River Basin

Drainage area	40M5/6 Capacity	40M5/6 Removal rate	55M5/6 Capacity	55M5/6 Removal rate	70M5/6 Capacity	70M5/6 Removal rate
	Channel development alternatives					
Sq.mi.	cfs	Inches	cfs	Inches	cfs	Inches
1	40	1.49	55	2.05	70	2.60
10	272.5	1.01	374.7	1.39	476.9	1.77
25	584.8	0.87	804.1	1.20	1,023.4	1.52
50	1,042.0	0.77	1,432.8	1.07	1,823.5	1.36
100	1,856.8	0.69	2,553.1	0.95	3,249.4	1.21

Source: Soil Conservation Service, United States Department of Agriculture.

Channels

During the study, 5,191 miles of proposed project channels were studied in the upstream watersheds of the delta area. To evaluate sizes of these project channels, a classification grouping according to drainage area was established. In addition, the channels were identified as to appearance - natural, man-made or previously modified, and no channel.

Of the 5,191 miles of channels classified, 3,242 miles or 62 percent have a drainage area less than 5 square miles in size, 4,213 miles or 81 percent have a drainage area less than 10 square miles in size, 4,810 miles or 92 percent have a drainage area less than 20 square miles in size, and 5,117 miles or 98 percent have a drainage area less than 50 square miles in size. The other 74 miles of channels have a drainage area greater than 50 square miles but less than 200 square miles.

The total channel miles estimated to be in a natural state were 3,080 miles or 59 percent of the 5,191 miles studied. These 3,080 miles of channels appeared natural because of their overall condition. Some of these conditions are: (1) the vegetation along the channels gave an aged appearance, (2) there were no spoil banks, and (3) the channel size was such that no signs of work were apparent. Some of these channels probably have been modified in the past. Channels with a man-made appearance totaled 1,880 miles or 36 percent. The other 231 miles or 5 percent were classified as having no channel. Table 7.13 shows other data on the classification.

In addition, where channel work was proposed for the various designs, the type of work was classified for each alternative design. Table 7.14 shows this data. For the 40M5/6 design 4,036 channel miles needed work.

Table 7.13. Channel classification of project channels studied by drainage area groups and type of present channel, delta-area, Yazoo-Mississippi River Basin, 1970

Group 1/	Type of channel									Area total		Basin total
	Natural appearance			Man-made appearance			No channel					
	Areas			Areas			Areas					
	1,2,3,4,5,6,7,8W	8E	Total	1,2,3,4,5,6,7,8W	8E	Total	1,2,3,4,5,6,7,8W	8E	Total	1,2,3,4,5,6,7,8W	8E	
	Miles											
1	1,417	461	1,878	1,007	160	1,167	125	72	197	2,549	693	3,242
2	434	120	554	381	15	396	20	1	21	835	136	971
3	301	68	369	205	10	215	9	4	13	515	82	597
4	168	39	207	100	0	100	0	0	0	268	39	307
5	47	16	63	2	0	2	0	0	0	49	16	65
6	9	0	9	0	0	0	0	0	0	9	0	9
Total	2,376	704	3,080	1,695	185	1,880	154	77	231	4,225	966	5,191

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Drainage Area

Group 1 - Less than 5 square miles.
Group 2 - Greater than 5 but less than 10 square miles.
Group 3 - Greater than 10 but less than 20 square miles.
Group 4 - Greater than 20 but less than 50 square miles.
Group 5 - Greater than 50 but less than 100 square miles.
Group 6 - Greater than 100 but less than 200 square miles.

Table 7.14. Channel classification of project channels studied by type of work and alternative design, delta-area, Yazoo-Mississippi River Basin, 1970

Type of work	40M5/6 Design			55M5/6 Design			70M5/6 Design		
	Areas			Areas			Areas		
Code 1/	1,2,3,4,5,6,7,8W	8E	Delta total	1,2,3,4,5,6,7,8W	8E	Delta total	1,2,3,4,5,6,7,8W	8E	Delta total
	Miles								
I	655	303	958	789	358	1,147	1,075	417	1,492
II	1,196	320	1,516	1,449	302	1,751	1,812	295	2,107
III	454	64	518	878	75	953	610	73	683
IV	866	178	1,044	738	145	883	518	102	620
None	1,054	101	1,155	371	86	457	210	79	289
Total	4,225	966	5,191	4,225	966	5,191	4,225	966	5,191

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Code of type of work.

I - Essentially a new channel.

II - Enlargement or realignment of existing channel or stream.

III - Cleaning out natural or man-made channel.

IV - Clearing and removal of loose debris within channel section.

None - No work planned.

The 55M5/6 design resulted in 4,734 miles needing work. The 70M5/6 design showed that 4,902 miles, which is all but 289 of the 5,191 miles studied, needed work.

Streambank Erosion

Two alternatives were considered for treating streambank erosion. The first alternative was to treat the severe and the moderately-eroding streambanks with both mechanical and vegetative measures. The second alternative was to control 70 percent of the drainage area with floodwater retarding structures in watersheds classified as severe and to treat the streambank of those classified as moderate with mechanical and vegetative measures. Mechanical measures include such items as concrete jacks, post retards, and slotted wood fences. Vegetative measures consist of establishing a vegetative cover such as grasses, kudzu, and willow trees on the streambanks to prevent erosion.

The estimated installation costs of the vegetative and mechanical measures used in alternative one is $22.4 million. The cost for alternative two, which consists of a combination of treating the banks and floodwater retarding structures to control runoff, is estimated to be $47.6 million. Alternative two would have an installation cost of $25.2 million more than alternative one. Table 7.15 shows these costs by subareas.

Table 7.15. Cost of two alternatives for treating streambank erosion, Yazoo-Mississippi River Basin, 1970

Subarea	Alternative one: Cost of treating streambanks (moderate and severe)	Alternative two: Cost 70% control in severe watershed plus treating streambanks in moderate watersheds
	Dollars	Dollars
9	14,116,256	25,243,680
10	1,664,504	1,664,504
11	2,807,856	4,992,126
12	806,888	806,888
13	2,977,584	14,858,584
Total	22,373,088	47,565,782

Source: Soil Conservation Service, United States Department of Agriculture.

Erosion and Sediment

Erosion and sediment problems and needs are identified in Chapter IV. These problems were expressed in terms of acres of land affected by erosion, miles of streambank erosion, and annual tons of sediment as a measure of the extent of erosion, and were related to average annual damages for 1980, 2000, and 2020. Potential solutions to controlling erosion and sediment are presented in table 7.16.

The more practical alternative means of damage prevention are proper use and treatment of the land, land use adjustments, and streambank protection by both mechanical and vegetative means. The costs of streambank protection were based on the severity of the problem and an average cost per mile for installation of appropriate measures. The remaining erosion and sediment costs were included in costs of other land treatment measures.

Table 7.16. Potential solutions to erosion and sediment problems, Yazoo-Mississippi River Basin

Item	Potential solutions
Erosion and sediment	Bank stabilization Sediment control structures 1/ Watershed management 2/ Revegetation

Source: River Basin Survey Staff, United States Department of Agriculture.
1/ Contour farming, ditch checks, and reservoirs.
2/ Land treatment measures such as changing cropping patterns, changing land use, or improving existing practices.

Excessive Wetness

Drainage problems were identified by land use and capability class and by land use by land resource areas (Chapter IV). Projected needs were based on land use expected to prevail in 1980, 2000, and 2020. It was assumed that no forestland would require drainage in the future. Alternative means of meeting drainage needs were considered as portrayed in table 7.17.

The more practical of these alternatives were installation of on-farm drains and intrafarm drainage improvements for crop and pasture land with this problem. Land treatment was another practical measure used.

Table 7.17. Potential solutions of excessive wetness problems and needs, Yazoo-Mississippi River Basin

Item	Potential solutions
Excessive wetness	On-farm drains Channelization Watershed management 1/

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Includes all land treatment measures such as changing cropping patterns, which will facilitate use of lands with high wetness.

Recreation

A detailed description of recreation is presented in Chapter IV. Existing recreation facilities provide over 34 million recreation activity occasions per year. The greatest problem is that demand for outdoor recreation out-strips the existing supply of some facilities as displayed in table 4.36. Potential solutions to recreation problems and needs are presented in table 7.18.

There is more than adequate large water in the basin to meet the space needs for boat docks, general boating, and water skiing. Water-related recreation development primarily for camping is also sufficient to meet basin needs through the year 2020. It is not sufficient to meet both basin needs and demands from outside the basin on the average weekend which is the period in which most recreation activity occurs. There is a need for further study to determine the amount of use from outside the basin, determine if this use will continue, and plan sufficient development to satisfy the exterior demand.

The greatest need for recreation development is trails. Four types of trails are considered in this study; horse trails, hiking trails, nature trails, and bicycle trails. Bicycle trails account for the largest share of trail demand with needs of 2.4 thousand miles or about 34 million activity occasions by the year 2020. Nature trails are second with needs of 1.6 thousand miles or about 14 million activity occasions. There is a net need of 442 miles of horse trails to provide about 2 million activity occasions per year and a net need for 265 miles of hiking trails to provide about 122 thousand activity occasions per year. Bicycle riding is generally an urban related activity since most of the participation is by young children and teenagers. Most of the demands for bicycle trails can be met by planning for this activity in urban development. Horse trails require a mixture of landscapes, but forest land is the primary setting. Due to ownership patterns, it will be more difficult to meet these needs. Some of the needs can be met by developing horse trails on the National Forests and around the

Table 7.18. Potential solutions to recreation problems and needs, Yazoo-Mississippi River Basin

Item	Potential solutions
Recreation	Facilities development Access development

Source: River Basin Survey Staff, United States Department of Agriculture.

four large reservoirs in the uplands. This would leave the delta and bluff hills portions of the basin almost void of this facility. Most of the needs for hiking trails and nature trails can be met by developing these facilities in conjunction with picnicking and camping. Picnicking and camping developments require a certain amount of land to buffer them from other land uses. These buffer areas can be developed for hiking and nature trails. This type of development is practiced by both the Mississippi Parks Commission and the U. S. Forest Service.

Other than trails, the greatest need for recreation development is play fields. This includes playgrounds, baseball diamonds, football fields, volleyball courts, and other organized sports as well as general open space to play games. The present net needs are 8.0 thousand acres, which are projected to increase to 12.0 thousand acres by the year 2020. Most outdoor games and sports are played in or near urban areas; therefore, these needs should be considered in urban planning. Sufficient acreage is reserved for this recreation use in urban expansion programs.

Other unmet needs in the basin are swimming pools, tennis courts, 18-hole golf courses, picnic sites, and boat storage facilities. Swimming pools, tennis courts, and 18-hole golf courses are primarily urban land uses and should be planned accordingly. Picnicking can be an urban use, but is primarily associated with forest lands. Most of the needs for picnicking can be met by expansion of already existing facilities. Boat docking facilities are directly related to large water areas. There is an ample supply of water area for development, but the docking facilities do not exist. There is a net need for the development of about 9.0 thousand boat slips, which would require 2.7 thousand acres of water space by the year 2020.

There is sufficient land and water space to meet all of the recreation needs within the basin by 2020. This land should be selected and reserved for future development under an early action program.

Fish and Wildlife

Demand, supply, and needs for fishing and hunting are presented in Chapter IV. Basinwide, there is an ample supply of water surface area to satisfy fishing demand through 2000. In the year 2020, there is a net need of 1.1 thousand acres of surface water in the delta and 5.4 thousand acres in the upland area for a total of 6.5 thousand acres. Potential solutions to meet fishing and hunting needs are presented in table 7.19.

The most practical solution to provide more man days of fishing is to use the existing water and improve the per acre production of the water. This would provide additional man days of fishing capacity without having to develop new waters and thereby tie-up land that could be producing crops, trees, or pastures.

Farm ponds in the uplands could produce many more pounds of fish if simple, relatively inexpensive fish management practices are employed. Proper construction, complete restocking, use of bottom flow drains, fertilization, and aquatic weed control are fishery management practices which could be employed at a fraction of the cost of new water development.

Table 7.19. Potential solutions to fishing and hunting needs, Yazoo-Mississippi River Basin

Item	Subarea	Potential solutions
Fishing	Uplands	Improved management of existing waters Purchase of private water Access development Lake and pond construction Raise existing lake levels
	Delta	Lake and pond construction Improved management of existing waters Access development
Hunting	Uplands and Delta	Purchase of additional lands Lease of additional lands Improved management of existing lands Increased interest in fee hunting by landowners Land use regulations preserving bottomland hardwoods

Source: Soil Conservation Service, United States Department of Agriculture.

Delta waters are less manageable and present difficult problems due to the drainage from croplands and other insecticide-related problems. Likewise, new water construction is more difficult and expensive in the delta, yet it is the only real solution to the long range needs for meeting the fishery demand in the delta.

Lake and pond construction for public use as well as purchase of private waters and access development can provide public fishing on "new waters" where before little or none has taken place. In some instances, existing lake levels can be raised to provide more surface acreage.

Based on the 1970 supply of harvestable game, there will be a basin deficit of 437,076 man days of hunting in the year 2000. Both the delta and the uplands show similar unmet needs for hunting resources beginning in the year 2020.

The overall outlook for hunting resources is not as bright as that for fishing resources. Increased pressure from sportsmen on a diminishing resource base will undoubtedly leave unmet needs.

Drastic changes in land use, extensive farming practices, clearing of bottomland forests, urban sprawl, and general environmental deterioration compound the problem of providing quality hunting in future years as compared with the quality of hunting existing in 1970.

Possible solutions are purchase of suitable lands, lease of suitable lands, improved management of existing lands to produce more game, and development of landowner participation in providing public hunting for a fee.

Without considerable investment by state and federal agencies in maintaining large blocks of land allowing hunting access, the outlook would be very dim. However, if these public lands are maintained and additional lands added by future purchase, the gap between the demands and supply may be narrowed.

Water Quality

Water quality control needs exist wherever pollutants are discharged to water supplies. Quantified needs herein were limited to organic or biodegradable wastes, and to bacteria. Organic pollutants are expressed in pounds of BOD_5 per day. Bacterial pollution is expressed in terms of flow in millions of gallons per day requiring treatment.

Table 4.60 displays industrial organic pollution control needs and table 4.62 displays municipal organic pollution control needs. The unsatisfied or net need shown in the 1970 column of the tables indicate

that significant pollution control problems exist in the basin. The more notable of these problem areas are the Mississippi River at Greenville, the Mississippi River at Vicksburg, and the Yazoo River at Yazoo City.

The Mississippi Air and Water Pollution Control Commission is the state agency responsible for the water quality management program in Mississippi. The Commission has programs for issuing point discharge permits, initiating enforcement actions against violators of water quality standards, supporting municipal sewage treatment plant construction, and conducting water quality monitoring and surveillance, plant operator training, laboratory analysis, and for river basin management planning. Although the Commission is designated as the certifying agency for the basin and metropolitan/regional water quality management plans in Mississippi, the planning activities are carried on by several other agencies and entities within the state with overview by the Commission. The North Central Mississippi Planning and Development District is designated to complete water quality management plans for most counties in the Yazoo-Mississippi River Basin. The Mississippi-Arkansas-Tennessee Council of Governments is currently developing a metropolitan-regional management plan that includes DeSoto County, Mississippi, which is partially within the basin.

Water quality problems may be dealt with in a number of ways as portrayed in table 7.20. Some solutions are viable and some are not viable in river basin planning. Chief among the potential solutions is the control of erosion and sediment -- a most important alternative in water and related land resource programs and plans. Land treatment measures are included in the recommended plan to minimize erosion and sediment.

Agricultural Pollutants

The agricultural pollution problems in the basin are identified and discussed in Chapter IV. These problems are insecticides, plant nutrients, animal wastes, and sediment. Sediment pollution problems are discussed separately. Increased levels of insecticides in man, fish, and wildlife as well as the basic air, water, and land resources have occurred. Plant nutrients, if they reach the surface and ground water sources, reduce the quality of both sources. Untreated animal wastes from confined animals primarily contribute to reduced air and water quality. Potential solutions for control of agricultural pollutants are presented in table 7.21.

The most practical potential solutions of insecticide pollution are control of the use and kinds of insecticides and develop alternative methods to control insects. The pollution from plant nutrients can probably best be controlled by reducing erosion and controlling sediment along with other watershed management items. The best method to control animal waste is waste treatment.

Table 7.20. Potential solutions to water quality problems, Yazoo-Mississippi River Basin

Water quality	Potential solutions 1/
5-Day BOD	Secondary waste treatment
Bacteria	Advanced waste treatment
Thermal	Underground disposal
Oil and grease	Assimilation 2/
Toxics	Mechanical reaeration
Turbidity	Increased industrial efficiency
Heavy metals	Control of sediment and erosion
Foam	Disinfection
Phenols	Sprinkler irrigation
Dyes	Lagooning
Ammonia	Incineration
Sulfite waste liquors	Cooling towers and cooling ponds
Iron	Pesticide control
Inorganic compounds	Fertilizer management programs
	Land spreading

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Potential solutions may apply to one or more of the items.

2/ Includes diversion of wasteload to stream, diversion of stream to wasteload, releases from reservoir storage, and natural assimilative capacity of streams.

Table 7.21. Potential solutions to agricultural pollution problems, Yazoo-Mississippi River Basin

Agricultural pollutants	Potential solutions 1/
Insecticides	Research
Plant nutrients	Reduce erosion
Nitrogen	Control sediment
Phosphorus	Watershed management
Animal wastes	Control use of insecticides
	Alternative methods of insect control
	Manage fertilizer use
	Control disposal of insecticide and fertilizer containers
	Waste treatment

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Potential solutions may apply to one or more of the items.

Health Aspects

The potential solutions to diseases associated with water or transmitted by vectors are limited to water quality improvement, vector control, and emergency preparedness. Satisfaction of any or all the requirements of the Water Quality Act Amendments of 1972 results in satisfaction of some portion of the basin's health needs. Water quality can be improved through treatment of water supplies and treatment of wastes. Disinfection with chlorine or another suitable chemical for bacteria control is the recommended alternative, not only for the reason stated earlier, but also because of its significance as a health measure. Vector abatement programs and emergency preparedness programs are also considered viable alternative ways in which the health of the basin's residents can be safeguarded and improved.

CHAPTER VIII

RECOMMENDED PLAN

The Water Resources Council Principles and Standards, published on September 10, 1973, in the Federal Register, Volume 38, Number 174, Part III, became effective on October 25, 1973. United States Department of Agriculture Procedures for Planning Water and Related Land Resources dated March 1974 state how the USDA will implement the conceptual basis embodied in the Principles and Standards in river basin activities.

The Principles and Standards require that the overall purpose of water and related land resource planning will be directed toward improvement in the quality of life through contributions to the objectives of national economic development and environmental quality.

The national economic development objective is to enhance the national development by increasing the value of the nation's output of goods and services and improving national economic efficiency.

The environmental quality objective is to enhance environmental quality by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources, and ecological systems.

These two objectives for planning water and related land resources were the dominant consideration in formulating the recommended plan. However, full compliance with the USDA procedures of March 1974 was not a requirement of this study.

Plan elements included in the formulation of this plan were those identified during the conduct of the study. An analysis of the beneficial and adverse effects of these elements upon the national economic development and environmental quality of the basin was made. The environmental quality components are an integral part of the recommended plan.

The plan, as recommended, was selected as the alternative that best meets the needs of the basin. The selection, made as the result of decisions during Field Advisory Committee meetings and informal discussions with local, state, and federal agencies and groups, as well as review and comments by local, state, and federal agencies, provides a recommended plan for the solution of some of the major water and related land problems of the basin.

Opportunities for resource development in the basin include both land treatment and structural measures for reducing economic losses due to floods, inadequate drainage, soil loss, sedimentation, land loss, and pollution. These measures are designed to provide better economic opportunities by enhancing both the quantity and quality of recreation, fish and wildlife habitat, changed land use, increased crop yields, increased wood production, and improvement of the environment.

Land

Land acreages are presented in table 8.1. These acreages, if the production requirements (crops, livestock, and wood products) for the basin as shown in Chapter III, table 3.6, are to be met, require that an accelerated water and related land resource development occur. This accelerated development is discussed in Chapter VII. Structural and non-structural measures must be installed to assure that production meets the requirements for the basin. The structural measures discussed in this chapter will reduce flood damages. The land treatment measures listed in table 8.7 will protect the land base and increase production efficiency.

Table 8.1. Acreage to meet identified land and water uses, Yazoo-Mississippi River Basin, 1970, and projected 1980, 2000, and 2020

Land use	1970	1980	2000	2020
	Acres	Acres	Acres	Acres
Cropland	3,640,000	3,751,000	3,638,500	3,642,700
Harvested	2,970,000	3,215,000	3,288,500	3,367,700
Pastured	326,000	320,000	200,000	175,000
Idle	344,000	216,000	150,000	100,000
Pasture	943,000	1,377,700	1,449,200	1,450,500
Forest	3,222,000	2,609,200	2,578,400	2,534,700
Other	291,000	253,000	230,000	163,000
Urban	258,000	335,000	361,000	426,000
Small water	103,000	119,100	119,100	119,100
Large water	90,000	102,000	171,000	211,000
Total area	8,547,000	8,547,000	8,547,000	8,547,000

Source: Formulated by River Basin Survey Staff, United States Department of Agriculture.

The recommended use of the land is not discussed in detail but several items are presented. Adequate land of the desired quality is available to meet the production requirements from the basin as outlined previously. However, to meet the demands for recreation and environmental components requires the setting aside of 287 thousand acres of land classed as forestland. Recreational developments require 70 thousand of the 287 thousand acres with the remaining 217 thousand being required for environmental purposes. Therefore, the meeting of the recreational and environmental needs results in essentially removing these 287 thousand acres from producing wood products.

When these set aside acres are subtracted from the total, the reduced forestland base for producing wood products is about 2.3 million acres for all time frames. On this reduced forestland base and with the projected growth rates, all demands for wood products are met for all time frames except 2020. To meet the demands of 138 million cubic feet for the year 2020 requires an accelerating growth from 55 cubic feet to 61.4 cubic feet per acre on every acre of the reduced base. This acceleration is above the going programs in the basin, including the Y-LT flood prevention project, state forestry programs, and private land management practices. A regenerating program on poorly stocked acres will be required.

Recreational land in sufficient quantity is available to meet the needs. The development of the needed trails as outlined in Chapter VII is doubtful. Adequate hunting land needs are not met. However the demands for other competitive land uses are met.

Water Surface Area

The allocated water surface area as presented in table 8.1 provides for sufficient water to meet all the basin needs. Small water surface area increases from 103,000 acres in 1970 to 119,100 acres in the year 2020. Large water surface area increases from 90,000 acres in 1970 to 211,000 acres in 2020. These acreages are inclusive of the 20,050 water surface acres provided for in the proposed floodwater retarding structures.

Flood Damage Reduction

Upland - The recommended alternative to reduce flood damages in the upland portion of the basin is evaluation number three as presented in Chapter VII. The plan includes presently installed land treatment measures, floodwater retarding dams and channels plus additional floodwater retarding dams, and land treatment measures. Tables 8.2 and 8.3 present structure data, costs, damages, and benefits by subareas for the recommended plan.

Table 8.2. Recommended plan,[1/] structure data, costs, damages, and benefits by subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea 9	Subarea 10, 12, 13	Subarea 11	Total
Floodwater retarding structures					
Installed	Number	155	56	83	294
Remaining to be installed	Number	181	187	96	464
Total	Number	336	243	179	758
Area controlled	Acres	704,223	534,380	296,007	1,534,610
Area controlled	Percent	47	29	32	36
Channel development					
Installed	Miles	17	303	199	519
Remaining to be installed	Miles	--	--	--	--
Total	Miles	17	303	199	519
Total installation cost					
Floodwater retarding structures					
Installed	Dollars	10,276,717	2,711,227	4,480,067	17,468,011
Remaining to be installed	Dollars	25,030,679	24,663,943	10,992,506	60,687,128
Channels (installed)	Dollars	93,257	6,015,054	2,943,477	9,051,788
Total	Dollars	35,400,653	33,390,224	18,416,050	87,206,927
Annual damages					
Present without project	Dollars	5,277,735	5,515,370	2,680,763	13,473,868
Reduction with project	Percent	65	56	58	60
Remaining	Dollars	1,840,566	2,427,906	1,131,906	5,400,378
Annual cost	Dollars	2,578,529	2,476,848	1,354,122	6,409,499
Annual benefits	Dollars	4,159,244	3,858,045	1,897,595	9,914,884
Benefits - cost	Ratio	1.61:1.0	1.56:1.0	1.40:1.0	1.55:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes all structural measures installed plus additional floodwater retarding structures.

Table 8.3. Comparison of damages, annual costs, annual benefits, and benefit-cost ratio, upland subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea 9	10	11	12	13
Annual damages						
Without project	Dollars	5,277,735	1,904,776	2,680,763	1,611,528	1,999,066
Reduction	Percent	65	77	58	24	58
Remaining	Dollars	1,840,566	447,076	1,131,906	1,223,901	756,929
Annual Cost	Dollars	2,578,529	943,508	1,354,122	587,395	945,945
Annual Benefits	Dollars	4,159,244	1,756,314	1,897,595	515,205	1,586,526
Benefit-Cost 1/	Ratio	1.61:1.0	1.90:1.0	1.40:1.0	.88:1.0	1.70:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Channel work has been excluded from remaining works of improvement in approved project plans. Net benefits foregone from channel deletions are environmental quality costs.

Present without project annual damages for the upland subareas (areas 9, 10, 11, 12, and 13) total $13.5 million. When the recommended plan is installed, damages will be reduced by 60 percent. The benefit-cost ratio is 1.55 to 1.0. Remaining damages total $5.4 million in the watersheds of the upland subareas.

Delta - The recommended alternative to reduce flood damages in the delta portion of the basin is based on a channel design of 55M5/6 as discussed in Chapter VII. However, at the time of detailed planning, outlets for these projects may dictate an alternative with less protection. The adopted alternative includes channel work and land treatment measures. Table 8.4 presents structural measures, annual costs, and annual benefits by subareas.

Present damages (before project) for the delta subareas (areas 1-8) total $24.6 million. After installation of the recommended measures, remaining damages are estimated to be $8.9 million. Annual benefits are estimated to be $18 million and annual costs are estimated to be $7 million. The benefit-cost ratio is 2.6:1.0.

Under present conditions, the area subject to flooding in the upstream watersheds total 1.5 million acres. After project installation, flooded acres are reduced to 1.3 million acres. Although the reduction in flooded acres is small, the duration of flooding is greatly reduced.

Table 8.4. Recommended plan - structural measures, annual costs, annual benefits, and benefit-cost ratio, delta portion of the Yazoo-Mississippi River Basin

Item	Channels		Total cost of structural measures	Damages		Annual		Benefit cost
	Studied	Needing improvement		Before project	Remaining	Costs	Benefits	
	Miles	Miles	Thousand dollars					Ratio
Based on 55M5/6 Areas 1,2,3,4,5,6,7,8W (566)	4,225	3,854	63,667.1	19,270.7	7,773.7	5,459.5	13,239.8	2.4:1.0
Area 8E (534)	966	880	17,374.9	5,313.4	1,100.9	1,597.5	4,782.4	3.0:1.0
Total	5,191	4,734	81,042.0	24,584.1	8,874.6	7,157.0	18,022.2	2.6:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

Structural Measures

All construction projects cause a change in the surrounding environment. These changes to the affected resources must be recognized and identified to assist in deciding how to plan, design, install, and maintain a project. Techniques and measures that are available to protect and enhance environmental values must be known by all who are involved in the project. The final project should have minimum detrimental effects and, when possible, should enhance some of the environmental factors. Consideration of environmental factors and available techniques to provide guidance in the development of a project are a part of all projects recommended. All detailed planning in the basin will include environmental considerations as well as economic and social well-being considerations.

Environmental factors include effects on aesthetic resources, wildlife resources, fish resources, and recreation resources. Techniques and measures to protect and enhance the environmental factors include design, installation, and maintenance items. Design measures such as protection of special features, placement of spoil, specifications for vegetation, and inclusion of landscape items add to the environmental quality. Special construction techniques are

necessary to minimize the effects of construction. Maintenance items must include measures that fully consider the environmental factors involved.

Impoundments - The recommended plan includes 758 floodwater retarding structures. These structures, when completely installed, will control floodwater runoff from 1.5 million acres or 36 percent of the upland subareas (areas 9, 10, 11, 12, and 13). The installation costs for the 758 structures totals $78.2 million (table 8.2).

The recommended 758 floodwater retarding structures include 294 structures that have been installed in watersheds presently in the operation stage. The remaining 464 structures include 135 structures that are planned for installation in current watershed work plans also in the operation stage. The additional 329 structures will require detailed planning of watersheds or amendments to watersheds presently in operation before installation. An acceleration of this planning and installation is recommended.

Additional data for these impoundment sites are presented in table 8.5. The table shows the extent of the area controlled by the impoundments, the committed storage, the total potential water storage, and water surface area available at the sites.

Channels - No new channel construction is recommended for the upland subareas (areas 9-13). However, some channel construction will probably occur in the upland subareas as some channel work has been planned. To date, 519 miles of channels have been improved. These should be maintained and stabilized where there is a bank caving problem. The estimated cost of channel improvement work completed to date is $9.1 million in the upland subareas (table 8.2).

The recommended channel work includes improvement on 4,734 miles of the 5,191 miles of channels studied in the delta. This work is needed in order to provide necessary outlets for farm water disposal systems. It is recommended that channel capacities be enlarged to a capacity of 55M5/6 to provide for the orderly removal of excess water from the land. Total installation cost is estimated at $81.0 million (table 8.4)

Streambank Stabilization - Alternative number one was selected for helping solve the streambank erosion problem in the basin (see Chapter VII, table 7.15). The measures are less expensive and are feasible to construct. Costs are estimated to be $22.4 million to install the structural and vegetative measures on 340 miles of streambanks in subareas 9-13. Measures to be installed include vegetation, post retards, slotted wood fences, jacks, overfall pipes, and drop inlet structures. The average annual costs of these measures are $2.1 million. The total annual benefits are $3.7

Table 8.5. Impoundments: Structure data for recommended plan - planned sites constructed and to be constructed, and additional proposed sites recommended, upland subarea, Yazoo-Mississippi River Basin

Subarea	Sites	Drainage area controlled	Extent of area controlled	Committed storage 1/	Potential storage	Total potential for sites: Storage	Total potential for sites: Surface area
	Number	Sq. Miles	Percent	Acre-feet	Acre-feet	Acre-feet	Acres
Area 9							
Planned sites	221						
Constructed	155	445.04	19	145,540	1,041,125	1,186,665	57,127
To be constructed	66	195.14	8	61,613	394,723	456,336	20,019
Additional sites	115	460.17	20	197,044	814,291	1,011,335	52,164
Total sites	336	1,100.35	47	404,197	2,250,139	2,654,336	129,310
Area 11							
Planned sites	115						
Constructed	83	190.60	13	53,966	454,279	508,245	21,933
To be constructed	32	42.08	3	12,939	99,218	112,157	5,620
Additional sites	64	230.02	16	92,477	459,933	552,410	25,645
Total sites	179	462.70	32	159,382	1,013,430	1,172,812	53,198
Areas 10, 12, 13							
Planned sites	93						
Constructed	56	85.19	3	27,159	207,043	234,202	11,947
To be constructed	37	90.01	3	29,091	213,277	242,368	13,641
Additional sites	150	659.97	23	267,997	1,378,006	1,646,003	80,693
Total sites	243	835.17	29	324,247	1,798,236	2,122,573	106,281
Summary areas 9-13							
Planned sites	429						
Constructed	294	720.83	11	226,665	1,702,447	1,929,112	91,007
To be constructed	135	327.23	5	103,643	707,218	810,861	39,280
Additional sites	329	1,350.16	20	557,518	2,652,230	3,209,748	158,502
Total sites	758	2,398.22	36	887,826	5,061,895	5,949,721	288,789

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Includes storage for sediment, floodwater, recreation, and fish and wildlife.

million and accrue from reduced deposition of sediment in streams and reservoirs, reduced damages to the environment and to fixed improvements, and reduced land loss and land voiding. The benefit-cost ratio is 1.8:1. Table 8.6 shows installation costs, annual costs, benefits, and benefit-cost ratios for streambank control.

Nonstructural Measures

An effective land treatment program is the basis for the conservation and development of the water and related land resources. It will maintain the productivity of these resources at no less than their present level to meet increasing product requirements. It is based upon the recognition that land and water resources are interdependent and must be used so that each reinforce the productivity of the other. Such a land treatment program is fundamental to the objectives of any water and related land resource development program. The practices needed to fulfill these objectives are conservation cropping systems, crop residue management, drainage practices, irrigation land leveling, pasture planting and management, wildlife habitat management, recreation area improvement, pond construction, diversions, grade stabilization structures, and critical area plantings. The amount and estimated costs of these measures are shown in table 8.7.

Land treatment measures can be installed with technical assistance provided through local soil and water conservation districts. These districts, established under State law as political units, encourage and support wise land use. Many of the land treatment measures, in addition to protecting the soil, also serve to enhance

Table 8.6. Streambank erosion data by subareas, Yazoo-Mississippi River Basin

Subarea	Areas to be treated	Total installation costs	Annual costs	Annual benefits	Benefit-cost ratio
	Miles	Dollars	Dollars	Dollars	
9	170	14,116,256	1,299,044	2,423,849	1.9:1
10	22	1,664,504	153,175	182,112	1.2:1
11	48	2,807,856	258,392	464,944	1.8:1
12	16	806,888	74,254	144,070	1.9:1
13	84	2,977,584	274,011	476,740	1.7:1
Total	340	22,373,088	2,058,876	3,691,715	1.8:1

Source: Soil Conservation Service, United States Department of Agriculture.

Table 8.7. Land treatment measures recommended and associated costs, Yazoo-Mississippi River Basin

Practice	Unit	Subareas 1-8		Subarea 9		Subarea 11		Subareas 10,12,13		Total	
		Amount	Dollars	Amount	Dollars	Amount	Dollars	Amount	Dollars	Amount	Dollars
Cons. cropping system	Ac.	2,323,288	4,646,575	16,252	121,890	55,134	413,505	96,200	721,500	2,490,874	5,903,470
Crop residue management	Ac.	2,042,683	8,170,732	-	-	-	-	-	-	2,042,683	8,170,732
Drainage field ditch	Mi.	5,828	3,374,487	1,375	687,500	1,081	540,500	1,771	885,500	10,055	5,487,987
Drainage main or lateral	Mi.	4,101	12,023,299	694	2,082,000	360	1,080,000	683	2,049,000	5,838	17,234,299
Irrigation land leveling	Ac.	218,039	32,487,862	-	-	-	-	-	-	218,039	32,487,862
Irrigation water management	Ac.	323,376	1,455,192	-	-	-	-	-	-	323,376	1,455,192
Pasture planting	Ac.	137,327	6,455,364	52,448	3,409,120	10,978	713,570	56,314	3,660,410	257,067	14,238,464
Pasture management	Ac.	228,112	3,649,805	-	-	-	-	-	-	228,112	3,649,805
Wildlife habitat management	Ac.	44,339	886,784	-	-	-	-	-	-	44,339	886,784
Wildlife wetland management	Ac.	45,801	1,374,026	-	-	-	-	-	-	45,801	1,374,026
Recreation area improvement	Ac.	861	34,447	-	-	-	-	-	-	861	34,447
Pond	No.	-	-	3,709	1,947,225	1,652	867,300	3,040	1,596,000	8,401	4,410,525
Diversion	Mi.	-	-	625	468,750	228	171,000	465	348,750	1,318	988,500
Grade stabilization structure	No.	-	-	3,220	1,288,000	282	112,800	1,283	513,200	4,785	1,914,000
Critical area planting	Ac.	-	-	242,360	3,368,804	55,950	7,777,050	93,770	13,034,030	392,080	24,179,884
Total		XXX	74,558,573	XXX	13,373,289	XXX	11,675,725	XXX	22,808,390	XXX	122,415,977

Source: Soil Conservation Service, United States Department of Agriculture.

natural environmental values. Drainage and flood control measures are essential on most cropland and pastures which occupy flat topography. Necessary outlets are essential to the construction of farm drainage systems. Farmers generally are not able to finance the costs of large channels. Sometimes these measures can be provided by groups of farmers pooling their resources to provide main channels and laterals. These practices can be cost-shared through programs administered by the Agricultural Stabilization and Conservation Service. The necessary technical assistance is provided by the Soil Conservation Service.

Land treatment measures included in the recommended plan are expected to be installed throughout the 50-year evaluation period. By the year 1980, approximately 25 percent are expected to be installed, an additional 50 percent by 2000, and the remaining 25 percent by the year 2020. Some of these are recurring and have to be repeated each year, or every few years. They include conservation cropping systems, crop residue management, pasture management, and wildlife management. Other practices such as drainage ditches, pasture planting, and diversions require periodic maintenance in order to function properly.

The land treatment measures include no costs for conversion of land from one use to another as in the case of forestland that would be cleared and put into pasture. The cost of clearing an acre of land varies according to the density of the forestland and amounts to from $100 to more than $200 per acre.

A regenerating program to accelerate timber growth is also necessary to meet the wood product demands by the year 2020. This can be accomplished by treating a part of the 563 thousand acres of forestland that are projected to be poorly stocked between the years 2000 and 2020. This poorly stocked land is producing an average of 29 cubic feet per acre per year. By regenerating 257 thousand acres of the poorly stocked forestland by the year 2020, the deficit supply of wood products caused by setting aside forestland for recreation and environmental purposes will be met.

Excessive Wetness

The recommended measures for excessive wetness are included in the land treatment program as presented in table 8.7. In addition, the recommended project channel work provides adequate outlets for on-farm wetness problems.

Environmental Measures

Continued and uncontrolled development of the water and land resources of the basin will have irreversible effects on the natural lakes and bottomland hardwood forests. Destruction of the shorelines of the lakes will destroy their intrinsic scenic beauty which cannot be fully restored. Likewise, the natural stands of bottomland hardwoods, once eliminated for agricultural or other pursuits, could not be fully restored or retrieved within the time span of human experience of present generations. Hence, there is a need for present decision makers to take positive short-term actions to preserve freedom of choice for future resource users. These actions should include the protection of 201 thousand acres of bottomland hardwoods in both the delta and uplands and the protection of 21 scenic lakes and their sparsely developed shorelines. They should also include protection of the Delta Hills Bluffs, preservation of 10 unique ecological systems and the creation of 8 thousand acres of open and green space in urban areas.

Lands recommended for primary use as environmental components are presented in table 8.8. The 21 scenic lakes recommended for protection are presented in table 8.9.

Some of the environmental quality component needs will require implementation by other programs outside present USDA authorities. These needs relate primarily to ecological areas, archeological and historical preservation, preservation of bottomland hardwood areas and some recreational facilities.

Plan Implementation

The recommended plan includes opportunities for USDA projects and programs to help meet the early action and long range needs of the basin. Among the programs are (1) the RC&D Projects that can provide for technical and financial assistance for many plan elements, (2) PL-566 watershed projects, (3) PL-534 watershed projects, (4) PL-46 technical assistance, and (5) FmHA financing to individuals and groups to help implement plan elements. The early action time frame extends to the year 2000; the long range time frame extends to the year 2020. Implementation will depend upon the availability of federal funds and the willingness of the local people to undertake the financial obligations necessary for project action.

Delta - All of the delta watersheds were found to be feasible for the installation of channels. The recommended plan includes 4,734 miles of channels to be improved to a capacity of 55M5/6. These improvements to channels, along with land treatment measures, are the major components of the plan for the delta. Mitigating measures, where feasible, are to be installed where damages may occur to fish and wildlife and to other environmental features.

Table 8.8. Lands recommended for exclusive use as environmental quality components, Yazoo-Mississippi River Basin

Feature	Land area	Existing use	Environmental quality attribute(s)
	1,000 acres		
Sharkey Bayou	2.5	Forest	Ecological system
Matthews Brake	0.7	Forest	Ecological system
Dutch Brake	0.7	Forest	Ecological system
Blue Lake Brake	0.8	Forest	Ecological system
Ashland Brake	1.0	Forest	Ecological system
Beckham Brake	1.0	Forest	Ecological system
Gayden Brake	1.1	Forest	Ecological system
Eagle Brake	0.9	Forest	Ecological system
Alcorn Brake	0.8	Forest	Ecological system
McIntyre Lake Area	0.4	Forest	Ecological system
Delta National Forest	5.0	Forest	Wilderness area
Delta Bluff Hills	1.1	Forest	Geological system
Urban open land	8.0	Urban	Green space
Bottomland hardwoods	201.0	Forest	Forest & wildlife area

Source: Adapted from The Environment, Appendix U, Lower Mississippi Region Comprehensive Study.

Table 8.9. Recommended preservation of lakes as environmental quality components, Yazoo-Mississippi River Basin

Lake	Remarks 1/
Eagle Lake	Acquire 200 acres of shore line
Big Mossy Lake	Acquire 75 acres of shore line
Six Mile Lake	Acquire 75 acres of shore line
Grassy Lake	Acquire 25 acres of shore line
Beaver Dam Lake	Acquire 75 acres of shore line
Lake Bolivar	Acquire 100 acres of shore line
Tchula Lake	Acquire 145 acres of shore line
Horseshoe Lake	Acquire 75 acres of shore line
Macon Lake	Acquire 25 acres of shore line
Hampton Lake	Acquire 25 acres of shore line
Bee Lake	Acquire 75 acres of shore line
Lake Jackson	Acquire 25 acres of shore line
Dump Lake	Acquire 100 acres of shore line
Moon Lake	Acquire 120 acres of shore line
Roebuck Lake	Acquire 100 acres of shore line
Wolf Lake	Acquire 75 acres of shore line
McIntyre Lake	Acquire 100 acres of shore line
Robinson Bayou	Acquire 75 acres of shore line
Lake Washington	Acquire 120 acres of shore line
Little Eagle Lake	Acquire 25 acres of shore line
Sky Lake	Acquire 100 acres of shore line

Source: Adapted from The Environment, Appendix U, Lower Mississippi Region Comprehensive Study.

1/ 200-ft. strip along shore line (24 acres per mile).

Much of the recommended plan located in subareas 1, 2, 3, 4, 5, 6, 7, and 8W can be implemented through the PL-566 watershed program. As presented in table 8.4, channel improvements in these eight subareas total 3,854 miles.

The additional 880 miles of channel improvement in the recommended plan is located in area 8E of the delta subarea. Area 8E is located in the authorized flood prevention project and these project measures can be implemented through the PL-534 program.

Due to monetary, physical, social, and institutional constraints, it appears impractical to plan and install all of these channel projects in the next 10 to 30 years. Therefore, the delta watersheds were reviewed to determine which would receive the most benefits from a watershed project. Several factors were evaluated for the various watersheds. These factors included (1) the percent of the watershed subject to flooding, (2) the present condition of channels in the watershed, (3) the percent of open land and forest in the watershed, (4) the benefit-cost ratio if the project was installed, (5) environmental elements, and (6) the effects that the major stream flooding has on the watershed.

The evaluation resulted in an overall factor for each watershed. These factors, along with professional judgment, were used to place the watersheds into groups which designate watersheds with the potential for returning the most benefits. All watersheds are feasible for improvements. However, those having recent projects installed, or having a large percent of forest, or lacking adequate outlets are not shown in the highest potential groups.

Two groups of watersheds included in the early action plan are shown in table 8.10. The group labeled as very high are those watersheds which were identified as having the best opportunities for watershed projects considering all of the factors listed above. The other group, labeled as high, are those watersheds which have lesser needs for projects. All other watersheds are feasible and do have opportunities for watershed projects but generally these projects will not result in beneficial returns that the very high and high groups will return (see map 8.1).

The watersheds that already have projects installed, are approved for operations, are being planned, or have a planning priority established are not included in the grouping. These existing projects are discussed in Chapter VI.

Table 8.11 presents the structural measures, annual costs, and annual benefits for the grouping of watersheds with the very high and high potential.

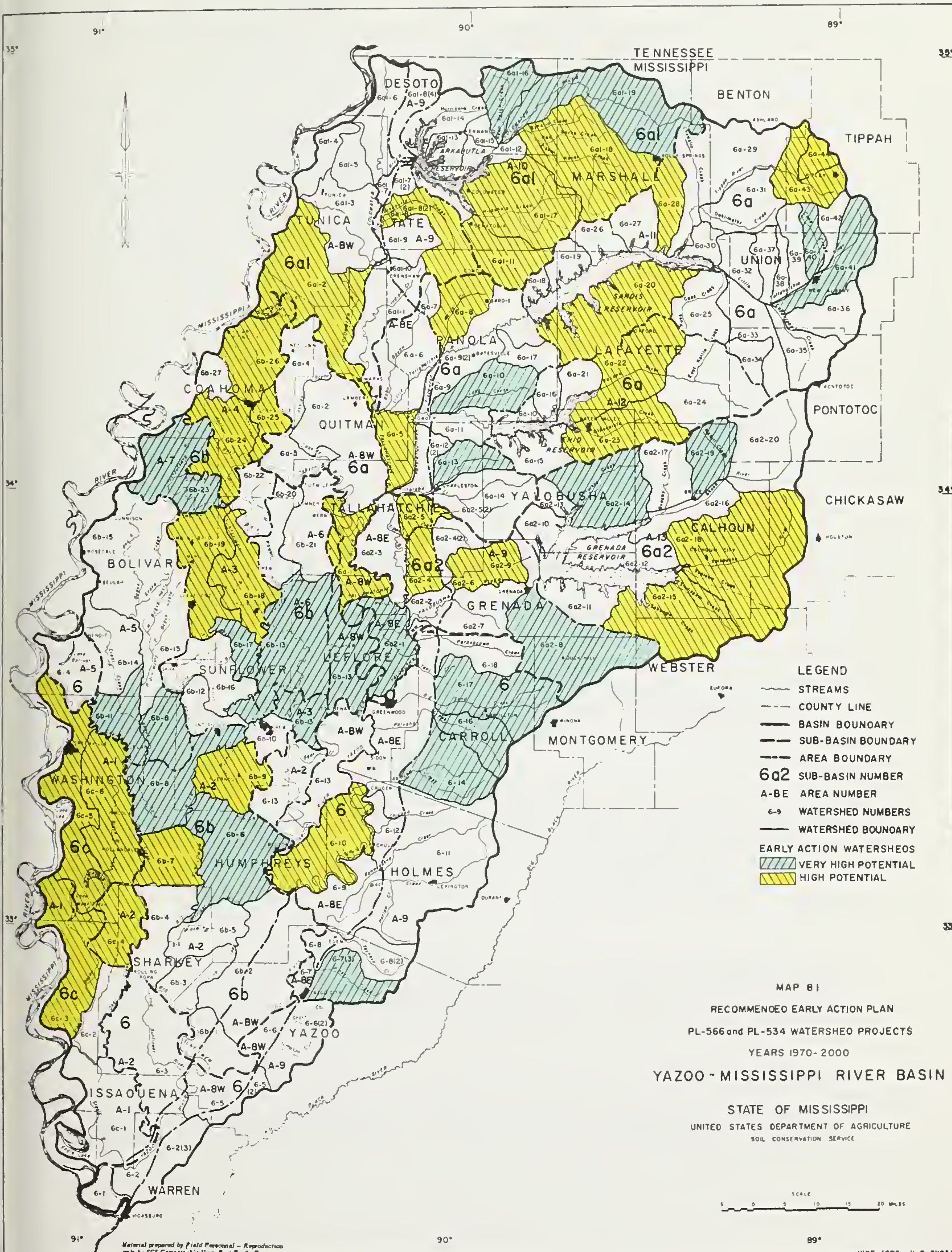

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Table 8.10. Identification of watersheds included in the early action plan, delta subarea, Yazoo-Mississippi River Basin 1/

Watersheds With Very High Potential		Watersheds With High Potential	
Area and Program		Area and Program	
8E (PL-534)	1,2,3,4,5,6,7,8W (PL-566)	8E (PL-534)	1,2,3,4,5,6,7,8W (PL-566)
Number	Number	Number	Number
6a2-1	6b-6	6-10	6c-3
	6b-8	6a-5	6c-4
	6b-11	6a2-4	6c-5
	6b-13	6a2-5	6c-6
	6b-17		6b-7
	6b-23		6b-9
			6b-18
			6b-19
			6b-24
			6b-25
			6b-26
			6a-1
			6a1-2

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Watershed numbers are those as shown on map 8.1.

As indicated previously, the remaining watersheds in the delta are included in the recommended plan but the returns from these installed projects are not as great as those projects identified in table 8.10.

Upland - The recommended plan includes 758 floodwater retarding structures along with 340 miles of streambank structural measures. These major structural measures, for control of floodwater and erosion and sediment damages along with land treatment measures, are the major components of the plan for the upland subareas (areas 9, 10, 11, 12, and 13).

All of the project measures located in upland watersheds north of Yazoo City can be implemented through the authorized flood prevention program, PL-534. Those watersheds that are located between Yazoo City and Vicksburg can be implemented through the PL-566 program.

The recommended plan, as stated previously, includes 758 floodwater retarding structures. Table 8.2 shows that 294 of these structures are installed and 464 remain to be installed. Included

Table 8.11. Watersheds included in the early action plan, structural measures, annual costs, annual benefits, and benefit-cost ratio, delta subarea, Yazoo-Mississippi River Basin 1/

Area and Program	Channels: Studied	Channels: Needing improvement	Total cost of structural measures	Damages: Before project	Damages: Remaining	Annual: Costs	Annual: Benefits	Benefit Cost Ratio
	Miles	Miles	- - - -	- - - -	-Thousand Dollars	- - - -	- - - -	Ratio
Watersheds with very high potential								
Area 8E (PL-534)	47.6	45.1	934.7	358.0	58.8	85.5	336.1	3.9:1
Areas 1,2,3,4,5, 6,7,8W (PL-566)	765.1	665.7	10,187.7	3,879.9	1,405.1	857.1	2,815.6	3.3:1
Total	812.7	710.8	11,122.4	4,237.9	1,463.9	942.6	3,151.7	3.3:1
Watersheds with high potential								
Area 8E (PL-534)	272.0	250.2	5,357.7	1,107.9	205.3	489.1	1,041.7	2.1:1
Areas 1,2,3,4,5, 6,7,8W (PL-566)	1,248.0	1,158.4	19,625.1	5,879.9	2,499.9	1,655.6	3,900.3	2.4:1
Total	1,520.0	1,408.6	24,982.8	6,987.8	2,705.2	2,144.7	4,942.0	2.3:1

Source: Soil Conservation Service, United States Department of Agriculture.
1/ Based on channel capacities where Q = 55M5/6.

in these 464 sites are 135 structures that are presently in watershed work plans in the operation stage. These can be installed as scheduled providing easements and rights-of-way are obtained by local watershed sponsors and construction costs and engineering services are available through PL-534 funds. None of the 135 sites are located south of Yazoo City. The estimated total installation cost for these 135 sites is $13.0 million.

The remaining 329 floodwater retarding structures can be installed through the PL-534 and PL-566 programs. None of these structures have been planned but are needed to provide additional reduction in flood damages. When complete, the structural system of floodwater retarding structures and the 519 miles of completed channel work will reduce flood damages by 60 percent and have a total installation cost of $87.2 million. Estimated annual costs total $6.4 million and estimated annual benefits total $9.9 million. The benefit-cost ratio is 1.55 to 1.00.

Work on projects to reduce flooding and other problems in the Yazoo-Little Tallahatchie flood prevention project has been in progress since about 1947. These existing projects are discussed in Chapter VI. Therefore, it seems impractical that the remaining 464 floodwater retarding structures will be planned and installed during the next 10 to 30 years.

To determine those watersheds having the most potential for inclusion in the early action plan, all upland watersheds were reviewed and evaluated. Factors used in this evaluation included present damages, damage reduction, remaining damages, benefit-cost ratios, channel stability problems, availability of structure sites, and environmental features. Watersheds were selected with the most potential in each subarea and were rated as very high or high. These watersheds and their potentials are shown in table 8.12. All watersheds included in table 8.12 have benefit-cost ratios exceeding 1.2:1.

The remaining watersheds have some potential for additional planning for structural measures to reduce damages. However, the benefit-cost ratio, availability of structure sites, and present land use were such that they were given a lower rating.

Structural measures, structure data, costs, damages, and benefits for the watersheds that have a very high potential are presented in table 8.13. Installation costs total $20.9 million. Damage reduction is 64 percent of the present without project annual damages.

Also, similar data for watersheds rated with a high potential are presented in table 8.13. Installation costs total $22.6 million. Damage reduction is 59 percent of the present without project annual damage.

Table 8.12. Identification of watersheds included in the early action plan, upland and bluff subareas, Yazoo-Mississippi River Basin 1/

Subarea 9	10	11	12	13
Number	Number	Number	Number	Number
		Very High Potential		
6-7	6al-16	6a-40	-	6a2-14
6-14	6al-19	6a-41	-	6a2-19
6-16				
6-17				
6a2-8				
6a-13				
6a-10				
		High Potential		
6a2-6	6al-11	6a-20	6a-22	6a2-15
6a-8	6al-17	6a-28	6a-23	6a2-18
6al-8	6al-18	6a-43		
		6a-44		

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Watershed numbers are those shown on map 8.1.

All of the streambank stabilization measures are to be installed through the Flood Prevention Program except below Yazoo City where PL-566 projects can be installed. The total estimated cost of installing these measures is $22.4 million. These measures are a part of the recommended plan and should be completed during the early action time frame so as to minimize losses from bank caving and sediment deposition downstream.

Streambank erosion is a serious problem in the basin both from the standpoint of land loss and silt and sediment deposition. The study indicates that 340 miles of streambanks could be effectively treated with stabilization measures such as concrete jacks, post retards, and vegetation. The annual costs, including operation and maintenance, are estimated to be $2.1 million (table 8.14). The benefits are $3.7 million annually (table 8.15). The benefit-cost ratio is 1.8:1.

Table 8.13. Selected data for watersheds[1/] included in the early action plan, upland subareas, Yazoo-Mississippi River Basin

Item	Unit	Subarea 9	Subarea 10, 12, 13	Subarea 11	Total
		Very high potential			
Floodwater retarding structures					
Installed	Number	84	9	5	98
Remaining to be installed	Number	49	41	14	104
Total	Number	133	50	19	202
Area controlled	Acres	269,557	127,080	24,291	420,928
Area controlled	Percent	52	41	27	46
Channel development					
Installed	Miles	--	28.8	30.7	59.5
Remaining to be installed	Miles	--	--	--	--
Total	Miles	--	28.8	30.7	59.5
Total installation cost					
Floodwater retarding structures:					
Installed	Dollars	5,504,040	267,045	171,000	5,942,085
Remaining to be installed	Dollars	7,057,755	5,639,840	1,671,000	14,368,595
Channels (installed)	Dollars	--	174,200	410,800	585,000
Total	Dollars	12,561,795	6,081,085	2,252,800	20,895,680
Annual damages					
Present without project	Dollars	1,882,250	853,959	269,585	3,005,794
Reduction with project	Percent	65	56	88	64
Remaining	Dollars	662,753	378,028	33,539	1,074,320
Annual cost	Dollars	913,330	446,531	168,280	1,528,141
Annual benefits	Dollars	1,750,456	636,503	287,217	2,674,176
Benefit - cost	Ratio	1.9:1.0	1.4:1.0	1.7:1.0	1.7:1.0

continued --

Table 8.13. Selected data for watersheds[1/] included in the early action plan, upland subareas, Yazoo-Mississippi River Basin (continued)

Item	Unit	Subarea			Total
		9	10, 12, 13	11	
			High potential		
Floodwater retarding structures					
Installed	Number	--	5	13	18
Remaining to be installed	Number	23	81	19	123
Total	Number	23	86	32	141
Area controlled	Acres	45,834	238,234	83,327	367,395
Area controlled	Percent	28	29	37	30
Channel development					
Installed	Miles	--	189.6	15.2	204.8
Remaining to be installed	Miles	--	--	--	--
Total	Miles	--	189.6	15.2	204.8
Total installation cost					
Floodwater retarding structures					
Installed	Dollars	0	209,181	488,514	697,695
Remaining to be installed	Dollars	2,943,000	11,213,403	3,173,253	17,329,656
Channels (installed)	Dollars	--	4,413,290	136,077	4,549,367
Total	Dollars	2,943,000	15,835,874	3,797,844	22,576,718
Annual damages					
Present without project	Dollars	525,313	2,909,954	823,167	4,258,434
Reduction with project	Percent	43	66	48	59
Remaining	Dollars	300,542	1,002,889	429,139	1,732,570
Annual cost	Dollars	214,044	1,169,495	279,890	1,663,429
Annual benefits	Dollars	283,653	2,270,023	465,111	3,018,787
Benefits - cost	Ratio	1.3:1.0	1.9:1.0	1.7:1.0	1.8:1.0

Source: Soil Conservation Service, United States Department of Agriculture.

1/ Watersheds in this table are shown in table 8.12.

Table 8.14. Annual costs of streambank stabilization, Yazoo-Mississippi River Basin

Subarea	Amortized installation cost	Operation and maintenance	Total annual cost
	Dollars	Dollars	Dollars
9	780,064	518,980	1,299,044
10	91,980	61,195	153,175
11	155,162	103,230	258,392
12	44,589	29,665	74,254
13	164,541	109,470	274,011
Total	1,236,336	822,540	2,058,876

Source: Soil Conservation Service, United States Department of Agriculture.

Table 8.15. Annual benefits from streambank stabilization, Yazoo-Mississippi River Basin

Subarea	Deposition in streams	Damage to environment	Deposition in reservoir	Damage to fixed improvements	Land depreciation	Land Voiding	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
9	1,272,592	351,029		30,179	602,817	167,232	2,423,849
10	3,842	59,993	3,074	29,650	67,987	17,566	182,112
11	31,671	79,598	11,059	152,539	150,818	39,259	464,944
12	11,318	22,874	4,013	47,134	46,601	12,130	144,070
13	25,060	124,393	9,022	10,233	248,313	59,719	476,740
Total	1,344,483	637,887	27,168	269,735	1,116,536	295,906	3,691,715

Source: Soil Conservation Service, United States Department of Agriculture.

Financing

The recommended plan will be financed with federal funds and local public or private funds. Generally, federal funds will be used to defray the cost of construction, engineering services, and administration of contracts. Non-federal funds will be used to obtain land rights and legal services for structural measures. Federal funds, through Public Law 566, will be used to finance planned structural measures in areas 1, 2, 3, 4, 5, 6, 7, and 8W. In the upland areas and area 8E of the delta, funds through Public

Law 534 will be used to finance recommended projects. Small local projects will be financed through RC&D funds where applicable. Non-federal funds will be provided by local watershed management districts, drainage districts, river basin water management districts, and any other local sponsors. These funds will be obtained from bond issues and loans, usually from the Farmers Home Administration. Loans to defray local cost of small watershed projects for flood control and/or recreation are available through the FmHA.

Land treatment measures for watershed protection will be installed by local landowners with technical assistance provided by soil conservation districts. Critical area treatment will be cost-shared with approximately 65 percent of the cost provided by federal funds and 35 percent from local non-federal funds. Technical assistance for critical area treatment will be provided by local soil conservation districts from federal funds.

All cost sharing between federal and non-federal local funds for structural measures are based upon past experiences which are subject to change dependent upon future programs.

The total installation cost of structural measures of the early action plan in the delta subareas is $36.1 million. Of this amount, $28.1 million is to be financed with federal funds and $8.0 million from non-federal local funds. Approximately $23.1 million will be provided from PL-566 funds and $5.0 million from PL-534 funds. Table 8.16 gives a breakdown of funds for the early action plan for the delta subarea by very high potential and high potential categories as well as the total early action plan.

For the recommended plan in the delta subarea, the total installation cost is $81.0 million, of which approximately $63.1 million is to be funded from federal funds and $17.9 million from non-federal funds. Of this $63.1 million, $49.3 million will be allocated from PL-566 funds and $13.8 million from PL-534 funds. Table 8.17 indicates the cost sharing summary for the recommended plan for the delta subarea

In the upland subareas, the early action plan has a total installation cost of $43.5 million for structural measures, with approximately $37.0 million provided from federal funds and $6.5 million from non-federal funds. Federal participation will come largely from flood prevention funds (PL-534). Some will come from RC&D sources, and a small amount will come from PL-566 funds for watersheds south of Yazoo City that are outside the flood prevention area. Table 8.18 shows the cost sharing summary data for the early action plan for upland watersheds by very high potential and high potential categories.

Table 8.16. Cost sharing summary for structural measures, early action plan, delta subareas, Yazoo-Mississippi River Basin

Item	Funds: Federal	Funds: Other	Funds: Total
	Dollars	Dollars	Dollars
Very high potential			
Areas 1,2,3,4,5,6,7,&8W (566)	7,895,600	2,292,100	10,187,700
Area 8E (534)	741,700	193,000	934,700
Subtotal	8,637,300	2,485,100	11,122,400
High potential			
Areas 1,2,3,4,5,6,7,&8W (566)	15,209,800	4,415,300	19,625,100
Area 8E (534)	4,251,200	1,106,500	5,357,700
Subtotal	19,461,000	5,521,800	24,982,800
Total early action plan - delta subarea			
Areas 1,2,3,4,5,6,7,&8W (566)	23,105,400	6,707,400	29,812,800
Area 8E (534)	4,992,900	1,299,500	6,292,400
Total	28,098,300	8,006,900	36,105,200

Source: Soil Conservation Service, United States Department of Agriculture.

Table 8.17. Cost sharing summary for structural measures, recommended plan,1/ delta subareas, Yazoo-Mississippi River Basin

Item	Funds: Federal	Funds: Other	Funds: Total
	Dollars	Dollars	Dollars
Areas 1,2,3,4,5,6,7,&8W (566)	49,343,100	14,324,000	63,667,100
Area 8E	13,786,500	3,588,400	17,374,900
Total	63,129,600	17,912,400	81,042,000

Source: Soil Conservation Service, United States Department of Agriculture.
1/ The recommended plan includes costs for all watersheds.

Table 8.18. Cost sharing summary for structural measures, early action plan, upland subareas, Yazoo-Mississippi River Basin

Item	Funds: Federal	Funds: Other	Funds: Total
	Dollars	Dollars	Dollars
Very high potential			
Area 9	10,677,500	1,884,300	12,561,800
Areas 10, 12, and 13	5,168,900	912,200	6,081,100
Area 11	1,914,900	337,900	2,252,800
Subtotal	17,761,300	3,134,400	20,895,700
High potential			
Area 9	2,501,600	441,400	2,943,000
Areas 10, 12, and 13	13,460,500	2,375,400	15,835,900
Area 11	3,228,100	569,700	3,797,800
Subtotal	19,190,200	3,386,500	22,576,700
Total early action plan - upland subarea			
Area 9	13,179,100	2,325,700	15,504,800
Areas 10, 12, and 13	18,629,400	3,287,600	21,917,000
Area 11	5,143,000	907,600	6,050,600
Total	36,951,500	6,520,900	43,472,400

Source: Soil Conservation Service, United States Department of Agriculture.

Table 8.19 shows the cost sharing summary of the recommended plan for the upland subareas. The total installation cost of structural measures is $87.2 million, with $74.1 million provided from federal funds and $13.1 million from non-federal funds. As with the early action plan, funding for the recommended plan, upland subareas, will come largely from PL-534 funds with a much less amount from PL-566 funds for those watersheds outside the flood prevention area. RC&D sources will also provide a small amount of funding.

The total installation cost for land treatment measures is $122.4 million. Of this amount approximately $17.6 million will be provided from federal funds with the remainder to come from local non-federal funds, mainly from private landowners.

The installation cost of streambank stabilization measures is $22.4 million. Federal funds (PL-534) will be used to finance approximately $21.7 million of this amount with the remaining $632 thousand to come from local non-federal funds.

Table 8.19. Cost sharing summary for structural measures, recommended plan,1/ upland subareas, Yazoo-Mississippi River Basin

Item	Funds		
	Federal	Other	Total
	Dollars	Dollars	Dollars
Area 9	30,090,600	5,310,100	35,400,700
Areas 10, 12, and 13	28,381,700	5,008,500	33,390,200
Area 11	15,653,600	2,762,400	18,416,000
Total	74,125,900	13,081,000	87,206,900

Source: Soil Conservation Service, United States Department of Agriculture.

1/ The recommended plan includes costs for all watersheds.

The cost, based on 1970 prices, of regenerating 257 thousand acres of forestland necessary to meet the 2020 demands is $11.4 million. Based on the present programs the cost will be 80 percent federal and 20 percent other. The Forestry Incentive Program approved and funded by Congress in 1974 will provide the 80 percent federal cost. This program is administered by the Agricultural Stabilization and Conservation Service in cooperation with the Mississippi Forestry Commission and the U. S. Forest Service.

Operation and Maintenance

Provisions for operation and maintenance will apply to all structural works of improvement and land treatment measures. Each legal organization that sponsors a watershed project will assume the responsibility to operate and maintain the floodwater retarding structures, stream channel improvements, and streambank stabilization measures among other structural measures. Critical area land treatment measures are to be maintained by local soil conservation districts or local landowners. The estimated costs of maintaining structural measures and streambank stabilization measures are shown in table 8.20.

Sponsoring Organization

Drainage districts, water management districts, and river basin districts have the authority to develop plans for works of improvement with agencies of the U. S. Government, and state and local governments. These districts also have the authority to enter into agreements with these agencies to meet the requirements of cost sharing; acquire by condemnation lands or other property for rights-of-way; and construct, operate, and maintain any kind of facility

Table 8.20. Estimated annual operation and maintenance costs of structural measures, Yazoo-Mississippi River Basin

Areas and item	Early action plan costs	Recommended plan costs
	Dollars	Dollars
Upland areas		
9	60,179	141,902
10, 12, 13	107,482	178,599
11	31,704	86,545
Total	199,365	407,046
Delta area		
1,2,3,4,5,6,7,8W	319,108	682,026
8E	52,117	154,812
Total	371,225	836,836
Streambank stabilization		
Area 9	518,980	518,980
Areas 10, 12, 13	200,330	200,330
Area 11	103,230	103,230
Total	822,540	822,540
Grand total	1,393,130	2,066,422

Source: Soil Conservation Service, United States Department of Agriculture.

in the basin necessary to the project. In addition, river basin districts have the power to acquire lands for recreation facilities, issue bonds, fix and collect charges for services, lease, sell, and dispose of property.

Owners and operators of land within each watershed (less than 250,000 acres) will be the primary motivating force in requesting technical and financial assistance in the planning, construction, operation, and maintenance of works of improvement. Landowners will petition and organize under appropriate laws of the state which provide for the participation of the federal government in planning and construction of works of improvement within organized drainage or water management districts.

Each local sponsoring organization will be responsible for working with appropriate federal agencies in the development of a watershed work plan. The work plan will identify those measures required to solve problems or provide for needs in the watershed.

Such plans will include estimates of the costs and benefits of proposed works of improvement, allocate costs to purposes, determine cost-sharing between the federal government and local people, and provide for the operation and maintenance of works of improvement or facilities.

There are many organized watersheds that have watershed work plans prepared. Where additional structural measures are needed, an amendment to the present plan will be required.

Community type conservation measures in RC&D projects, planned and installed through the RC&D program, will be sponsored by existing local governmental agencies such as Boards of Supervisors, School Boards, and Boards of Aldermen.

Soil conservation districts will act as co-sponsor for each watershed project and will be responsible for carrying out accelerated land treatment measures mainly on critical area land as identified in the work plan.

It is recommended that local sponsors and the private sector develop most of the facilities for non-water based recreation, wildlife facilities, ecological systems, geological systems, green space, semi-wilderness areas, and acquire shore line acreage.

Coordination With Other Agencies

Close coordination with other state and federal agencies will be maintained during the planning and installation of individual watershed projects.

One of the major problems in planning and installing channel improvement work is adequate outlets. The Corps of Engineers, in many cases, must provide outlets for small watershed projects before they can be constructed in the delta. Close coordination will be maintained to insure that outlets are adequate prior to construction.

In some cases, works of improvement will cause adverse effects. Some of these effects will be only temporary and others permanent. Close coordination will be maintained during the planning and construction of floodwater retarding structures, channel improvement work and stream stabilization measures with appropriate state and federal agencies. Where feasible, necessary measures will be employed to offset or minimize adverse effects.

One of the most critical problem areas is the bluff stream area--Area 9--and the delta area east of the major rivers--Area 8E. The upland part of this problem area has the most serious streambank erosion problem of the basin. This erosion problem, effected by

projects on the main rivers of the basin as well as in upstream areas, is such that more detail study is needed. Also, the area below Yazoo City contains upland area that has received very little, if any, land treatment and needs closer review. In addition, critical erosion problems still exist in the other upland areas of Area 9. A coordinated study with the Corps of Engineers would be desirable to more clearly identify the problems, to define areas of responsibility as well as to time the projects to conform to the resources of the USDA and Corps of Engineers.

Flooding problems of the area between the bluff hills and the major rivers are different than those of the remaining delta area. In addition to being subject to floods from direct heavy precipitation, flooding also occurs from overflows from the major rivers and the smaller tributaries that flow from the bluff hills. Projects along the major rivers, along the smaller tributaries, and the channels and laterals in local areas all affect flooding conditions. Close coordination among the Corps of Engineers, the Soil Conservation Service, and local drainage districts is required to insure a proper solution.

CHAPTER IX

IMPACTS

General

The early action plan is a complementary and economically feasible combination of projects and measures to satisfy water and related land resources problems and needs of the basin. The primary needs are for flood control, erosion and sediment control, improved conservation management systems, reduction in agricultural pollution, and improvement to the environment. The early action plan will satisfy a portion of these needs.

Plan elements of the early action plan that can be implemented through USDA program assistance are identified. Table 9.1 provides data for the plan elements proposed for inclusion in the early action plan that extends to the year 2000 and for the total recommended plan to be installed by the year 2020. In addition, the table contains estimates of the benefits and costs for the elements evaluated.

The capability of the recommended plan to satisfy the component needs of the basin was evaluated. Component needs were correlated with the National Economic Development Objective and the Environmental Quality Objectives as shown in table 9.2. The component needs and plan elements are enumerated and the magnitude of each plan element is quantified. The capability of the recommended plan to satisfy identifiable needs is shown along with the unmet needs.

The impacts of the early action plan are discussed below. In addition, a system of accounts is included to display beneficial and adverse effects of the plan on the components of the national economic development and environmental quality objectives and on regional development and social well-being.

Land

Land to meet the demands for recreational and environmental components includes a recommendation that 287 thousand acres of forestland be set aside for these purposes. This reduces the forestland base. This reduction means that these acres will not be managed for commercial purposes and will not contribute significantly to the production of wood products. This reduced base will meet the wood product demands for the year 2000. A regeneration on forestland totaling 257 thousand acres is required to meet the demands by 2020.

Table 9.1. Display of plan components that are proposed for implementation through USDA authorities, Yazoo-Mississippi River Basin

Components & plan elements	Unit	Early action by 2000	Total plan elements by 2020	Early action average annual: Benefits by 2000	Early action average annual: Cost by 2000
				- - -thousand dollars - - -	
Flood damage reduction					
Upland					
Floodwater retarding structures	Number	227	464	5,693 1/	3,192 1/
Channels	Miles	0	0	-	-
Delta					
Floodwater retarding structures	Number	0	0	0	0
Channels	Miles	2,119	4,734	8,094	3,087
Associated land treatment measures	Acres	1,064,000	2,100,000	- 2/	6,000
Erosion and sediment damage reduction					
Gully and critical area stabilization	Acres	294,000	392,100	- 2/	1,100
Roadbank stabilization	Acres	8,200	8,200	- 2/	49
Streambank stabilization	Miles	340	340	3,700	2,059
Other conservation management systems	Acres	1,000,000	1,500,000	- 2/	2,700
Grade stabilization structures	Number	4,785	4,785	- 2/	192
Improved timber management					
Tree planting	Acres	173,000 3/	173,000 3/	- 4/	3/
Stand improvement	Acres	84,000	84,000	- 4/	101
Agricultural pollution reduction					
Animal waste treatment units	Number	895	895	5/	147

Source: River Basin Survey Staff, United States Department of Agriculture.

1/ Includes benefits and costs for previously installed 116 floodwater retarding structures and 264 miles of channels.

2/ Land treatment benefits were not evaluated.

3/ Included in the critical area stabilization acres shown above.

4/ Monetary benefits value not evaluated. Increased average annual timber production amounts to 640,000 cubic ft./year.

5/ Benefits not evaluated.

Table 9.2. Capability of recommended plan to satisfy component needs, Yazoo-Mississippi River Basin

Objective	Component Needs Description	Unit	Quantity	Recommended Plan Provides	Recommended Plan Remaining Needs
National Economic Development (NED)	1. Flood damage reduction				
	Upstream watersheds	Acres	1,973,000	1,926,000	47,000
	(annual damages)	Dollars	33,597,600	19,322,600	14,275,000
	Principal streams	Acres	2,800,000	-	-
	(annual damages)	Dollars	12,164,000	-	-
	2. Improve production efficiency (crops and pasture)	Acres	2,100,000	1,600,000	500,000
	3. Erosion and sediment damage reduction				
	Gully and critical area stabilization	Acres	490,000	392,100	97,900
	Roadbank stabilization	Acres	8,200	8,200	0
	Streambank stabilization	Miles	340	340	0
	Other conservation management systems	Acres	1,900,000	1,500,000	400,000
	Grade stabilization structures	Number	5,500	4,785	1,715
	4. Wood production				
	Tree planting	Acres	173,000	173,000	0
	Stand improvement	Acres	84,000	84,000	0
	5. Land required to sustain agricultural and forestry outputs				
	Cropland	Acres	3,642,700	3,642,700	0
	Pasture	Acres	1,450,500	1,450,500	0
	Forest	Acres	2,534,700	2,534,700	0
	Commercial fish ponds	Acres	35,000	35,000	0
	6. Recreation				
	Hunting	Man days	1,284,400	0	1,284,400
	Fishing	Acres	6,500	6,500	0
	Facilities - land area	Acres	144,600	144,600	0
	water area	Acres	2,700	2,700	0
Environmental Quality (EQ)	1. Protect bottomland hardwoods	Acres	1/	201,000	-
	2. Protect geological system (Delta Bluff Hills)	Acres	1/	1,100	-
	3. Protect forest along recreation trails	Acres	1/	70,000	-
	4. Preserve wilderness area - Delta National Forest	Acres	1/	5,000	-
	5. Develop urban open and green space	Acres	1/	8,000	-
	6. Preserve ten ecological systems	Acres	1/	9,900	-
	7. Protect twenty-one lakes: flat water	Acres	1/	21,400	-
	shore lines	Acres	1/	1,735	-
	8. Erosion and sediment damage reduction		Same as NED - number 3 item		
	9. Agricultural pollution reduction				
	Animal waste treatment units	Number	895	895	-
	10. Recreation		Same as NED - number 6 item		

Source: River Basin Survey Staff, United States Department of Agriculture.
1/ Specific amounts not quantified.

Other items that affect the basin are the changes in the required acres for the various land uses. These changes mean that land use conversions must take place. Water surface acres are projected to increase from 193 thousand in the year 1970 to 290 thousand acres by the year 2000. This 97 thousand acre increase in water surface area means that this former land will be converted and be available only for water uses.

Forestland acres are projected to decrease from 3.2 million in 1970 to 2.6 million by the year 2000. Pasture land is projected to increase from 943 thousand acres in the year 1970 to 1.4 million acres by the year 2000. This increase in pasture will require land conversion from other uses, primarily forestland. Urban and built-up areas are projected to require an additional 103 thousand acres by the year 2000. Cropland is projected to remain about the same, except that harvested land will increase by 319 thousand acres by the year 2000. Combined pasture and idle cropland decrease by 320 thousand acres.

Flood Damage Reduction

The early action plan, when installed, will result in reducing flood damages by 33 percent in the bluff and upland subareas. When the early action plan measures are installed in the delta subareas, flood damages will be reduced by 29 percent.

This reduction in flooding means that farm operators can better manage their operations in the flood plains. Delayed land preparation and planting of crops caused by flooding will be less frequent and on some land will cease to be a problem. Also, crop and pasture damages will be reduced. Increased yields can be expected. Fixed farm improvements will require less maintenance and land values should increase.

The installed projects will reduce flood damage to roads, highways, and railroads, and other improvements such as pipelines, underground utilities, and other utilities. This reduction in damage will result in less maintenance. Also some cropland that has reverted to a less intensive use because of flooding can be restored to former use.

The installation of measures to reduce flood damages will result in changing the land use on acres required for installation. Also, the project measure may result in some flood plain forestland being converted to other uses. Approximately 60 percent of the land in the permanent pools of the floodwater retarding structures is open and will be lost from the production of crops and pasture. The remaining 40 percent will be lost from forest production.

Impoundments - The early action plan includes 343 impoundment sites to reduce floodwater and sediment damages. These sites, located in the upland subareas of the basin, provide storage for sediment in the normal pools and storage for floodwater and sediment in the flood pools. The sediment storage pools or normal pools generally provide a permanent water surface area which means that these acres have been converted to water. The 343 sites will provide 12,997 acres of water surface in these normal pools. As 116 of these sites are presently installed with normal pool areas totaling 2,977 acres, the remaining 227 sites will provide 10,020 acres of water surface. These 10,020 acres will be converted from land area to water area and will not, in most instances, be available for crop, pasture, and timber production.

The flood pools or areas provided for storage of a small part of the total sediment storage and for floodwater storage will be subject to temporary flooding during periods of storm runoff and during the drawdown time required to release the floodwaters from the sites. A total of 28.8 thousand acres of land will be subject to this temporary flooding. Therefore, the use of these acres will be restricted. The 116 constructed sites presently have 6.2 thousand acres subject to this temporary flooding. The remaining 227 sites in the early action plan, when installed, will restrict the use on 22.6 thousand acres of additional land. Table 9.3 presents data on the water surface areas for the 343 sites.

Table 9.3. Impoundment water surface available for the early action plan, upland subareas, Yazoo-Mississippi River Basin

Item	Sites	Water surface
	Number	Acres
Constructed sites	116	-
Normal pool	X	2,977
Flood pool	X	9,137
Additional sites	227	-
Normal pool	X	10,020
Flood pool	X	32,620
Total sites	343	-
Normal pool	X	12,997
Flood pool	X	41,757

Source: Soil Conservation Service, United States Department of Agriculture.

Channels - Channel structural measures in the early action plan are limited to the delta subareas. The plan includes 2,119 miles of channel work on the 2,333 miles of channels studied. Of the 2,333 miles studied, 62 percent have a drainage area less than five square miles, 19 percent have a drainage area between five and ten square miles, 12 percent have a drainage area between 10 and 20 square miles, 6 percent have a drainage area between 20 and 50 square miles, and 1 percent has a drainage area of more than 50 but less than 200 square miles. As these data reveal, 81 percent of the channels studied have drainage areas of less than 10 square miles and 93 percent of the total have drainage areas less than 20 square miles. Generally, delta channels with drainage areas of less than 20 square miles in size are ephemeral or intermittent. However, they are not useful as dependable water sources. During dry periods small holes, small lakes, and low areas provide water. The remaining 7 percent of the channels have drainage areas greater than 20 square miles in size. These streams are generally intermittent or perennial, depending on the channel depth. These stream flows may provide a small dependable source of water.

Channel work is required on 2,119 miles and consists of four general types according to intensity. Two types of construction on 1,290 miles involve the most excavation and land requirements. This work will result in essentially a new channel on 504 miles and enlargement or realignment of the existing channel on 786 miles. The other two types of construction consists of cleaning out 424 miles of natural or man-made channels and clearing and removal of loose debris within present channel sections on 405 miles.

The channels provide outlets for on-farm water removal systems. Duration of land flooding is reduced by the increased channel capacities. In addition, flooding on 89.6 thousand acres will be eliminated.

The channel work will probably result in increased sediment yields downstream. Therefore, the sediment will reduce environmental values of the streams. However, construction techniques to reduce erosion during the construction period and early establishment of vegetative cover will be used to minimize sediment yields.

Land requirements necessary to install the channels, spread or pile the resulting spoil, and to provide access for maintenance amount to about 21,190 acres. This land will be removed mainly from crop production. Part of the land where spoil is spread may return to crop production. Some affected land will be seeded to crops for wildlife food and cover. Also, landscape plantings will be made to improve the visual quality.

Land Treatment Measures - Land treatment measures to be installed will reduce flooding, erosion and sediment deposition, and will provide food and cover for wildlife. Land treatment measures include such items as conservation cropping systems, crop residue management, pasture planting and management, wildlife habitat management, pond construction, critical area plantings, and forestry practices. These measures will add to the scenic beauty of the basin by replacing eroded and bare areas with grasses and trees. They will help to control runoff by increasing the infiltration rates of the soil. Mechanical practices such as diversion terraces will tend to help control surface runoff.

Fish and wildlife conditions will be enhanced. Grasses and legumes will provide food and cover for wildlife and the additional water area created by the construction of farm ponds will provide additional fishery habitat.

Erosion and Sediment

Volumewise, sediment is the major pollutant of streams. Sediment damages cropland, pasture, and forestland. Approximately 34 percent of the land area in the basin is affected by erosion. Average gross erosion on the affected land in 1970 was 5.8 tons per acre per year. By 2000, this rate of erosion is projected to be 4.7 tons per acre per year or a 19 percent reduction.

There are 2,767 miles of streambank in the basin affected by erosion. In addition to erosion of the beds and banks of streams, sediment enters streams with surface runoff from sources such as sheet erosion, gullies, and roadbanks.

The land treatment measures, floodwater retarding structures, and streambank stabilization measures will decrease erosion and sediment damage by about 65 percent by the year 2000. This reduction in erosion and deposition of sediment benefits fish and wildlife habitat, water quality, aesthetic values, recreation resources, road and channel maintenance, crop yields, forest yields, and land values.

Economics

The early action plan will provide annual benefits in the amount of $8.1 million in the delta watersheds and $5.7 million in upland watersheds, for a total of $13.8 million. Of this amount, $12 million will be from damage reduction and $1.8 million will be redevelopment and secondary annual benefits. Annual damages will be reduced approximately 29 percent in the delta and 33 percent in the upland area. These benefits will increase the income to landowners and will increase trade activity within the basin.

The land needed to meet the estimated production for the seven major crops (soybeans, cotton, wheat, grain sorghum, rice, oats, and corn) in the year 1980 would require approximately 3.3 million acres for the without resource development situation and 2.9 million acres for the with development situation. Approximately 400.0 thousand less acres will be required with an estimated savings in production costs of $4.4 million annually.

The total expenditure for the early action plan amounts to $182.0 million. This includes installation costs for floodwater retarding structures, channel improvements, streambank stabilization measures, and land treatment practices. In addition, operation and maintenance costs on structural measures will amount to $1.4 million annually. Most of the labor and some of the materials used in the installation of the early action plan will come from local sources. The expenditure of these funds for both installation and operation and maintenance will benefit the economy of the basin by putting additional money into circulation and increasing the trade activity.

Fish and Wildlife

The impacts on fish and wildlife resulting from implementation of the early action plan are the combined effects of land use changes which affect the quantity and quality of fish and wildlife habitat. Table 9.4 shows the net land use changes expected under the early action and recommended plans.

Table 9.4. Estimated net change in land and water use, Yazoo-Mississippi River Basin, 1970 to 2020

Land or water use	Total change: 1970 - 2000	Total change: 1970 - 2020
	Acres	Acres
Cropland	- 1,500	+ 2,700
Harvested	+318,500	+397,700
Pastured	-126,000	-151,000
Idle	-194,000	-244,000
Pasture	+506,200	+507,500
Forest	-643,600	-687,300
Other	- 61,000	-128,000
Urban	+103,000	+168,000
Small water	+ 16,100	+ 16,100
Large water	+ 81,000	+121,000

Source: Based on land use data presented in Chapter VIII.

Total cropland shows a net decrease of 1.5 thousand acres from 1970 to 2000. This net change in itself is not significant, but the cropland mix is significant. Harvested cropland is projected to increase 318.5 thousand acres, pastured cropland is projected to decline 126.0 thousand acres, and idle cropland is projected to decline 194.0 thousand acres. The additional harvested cropland will be primarily cotton, soybeans, rice, and small grains. Other than cotton, these additional harvested acres will provide supplemental food for small game, forest game, and migratory birds such as dove, duck and non-game species. The overall impact will be negative as the reduction of idle cropland and pastured cropland, which generally produce high quality wildlife habitat, will not be offset by increasing the production of harvested crops. Harvested crops can only produce supplemental food for wildlife. Idle cropland and pastured cropland produce cover as well as food.

The increase of 506.2 thousand acres of pastureland will have a detrimental impact on wildlife values. Pasture is inherently poor wildlife habitat. Land, before being cleared for pasture is generally more productive for wildlife than the developed pasture.

There is a net loss of 643.6 thousand acres of forestland. This is probably the most damaging land use change as far as fish and wildlife values are concerned. Much of this loss would result from clearing bottomland hardwood, mixed upland pine hardwood, or upland hardwood timber types. These are extremely important for forest game habitat. There is no substitution for hardwood forest for squirrel and turkey. Although deer do well in a farmland-pastureland-cropland mixture, they also do equally as well in forest habitat. Clearing of large acreages of forestland will be detrimental to both game and non-game wildlife species.

There will be a detrimental impact of fishery habitat caused from clearing the forestland. Such clearing will cause accelerated erosion and subsequent siltation of lakes, ponds, and streams in and below the cleared area. Off-site damages of this nature can be far removed from the cleared area.

Other land is generally excellent upland game habitat. Ditch banks, fence rows, streambanks, spoil banks, roadside rights-of-way, and other such lands are included in the category. These are typically the "edge" habitats (ecotones) which are high quality wildlife habitat. In addition to being good habitat, these lands provide safe travel corridors for terrestrial wildlife through hazardous open areas. The reduction of 61.0 thousand acres of other land will have an adverse impact on wildlife resources.

Urban land will increase by 103.0 thousand acres by the year 2000. This will be a detrimental impact on wildlife and fishery habitat. Most of the land converted for additional urban use will

come from idle land and forestland. This conversion will eliminate habitat for wildlife. Lakes, ponds, and streams in the basin will be adversely affected by erosion and sediment damage.

Small water will increase by 16.1 thousand acres and is a beneficial impact. The development of small ponds creates more fishery habitat and adds diversity to the wildlife habitat of the surrounding area. Pond edges grow up into cover areas for wildlife and the addition of such waters can aid wildlife as a source of surface water during dry periods.

There is a surplus of approximately 27.0 thousand acres of fishing waters in the basin in the year 2000. The projected estimate of 81.0 thousand acres of large water includes 10.0 thousand acres in flood control reservoirs in the uplands. The remaining 71.0 thousand acres of water over 40 acres in size are not identified by location but will probably be constructed in the uplands. The land used for this new water will come largely from forestland, pasture land, or cropland, creating needs for these land uses that have to be met elsewhere. This land use conversion creates an adverse impact on wildlife as valuable habitat will be lost.

There are 2,119 miles of channel work planned for the delta portion of the basin--none in the uplands. This channel work represents 91 percent of the streams studied. Of this amount, 1,290 miles will involve the greatest amount of excavation and land requirements. This work will result in essentially a new channel on 504 miles and enlargement or realignment of an existing channel on 786 miles. The other 829 miles will involve primarily clearing and snagging type work.

The impact will be damaging to fish and wildlife values in the delta. Much of the wildlife cover located along streams and channels is in relatively narrow strips. Major construction work on 1,290 miles of streams will involve the elimination of at least one side of the edge vegetation and often both sides. The impacts of this will be calamitous for terrestrial wildlife that live in these bands of timber and use them as travel corridors. Further detrimental effects will accrue to the periled delta fisheries as the work will cause more siltation and turbidity in the downstream waters.

The installation of the channels will eliminate seasonal flooding of 89.6 thousand acres of land and reduce the frequency and duration of flooding on 880.4 thousand acres. This will create an adverse impact on winter time waterfowl habitat.

To summarize the impacts on fish and wildlife resources under the recommended plan there will be:

1. Continued deterioration of bottomland hardwood resources and other forest types critically needed for forest game habitat.

2. A reduction in upland game habitat by conversion of idle land, other land, and pastured cropland into more harvested cropland, pastures, and urban areas, and the development of 81.0 thousand acres of large water areas.

3. A further deterioration of delta fish and wildlife resources brought about by additional clearing of forests.

4. An expected increase in mourning dove populations due to increased production of harvested crops such as soybeans and small grains.

5. A significant reduction in habitat for squirrel, turkey, and other forest game.

6. Severe impacts to delta stream-side habitat caused by planned work on 2,119 miles of channels.

7. Improved stream habitat conditions in the uplands for fish and wildlife due to no stream modification work being planned for the uplands and the installation of land treatment measures.

8. Loss of revenue generated by hunting and fishing as game and fish habitat decline.

Recreation

The early action plan will have no significant effect upon recreational facilities. The water and land supply is generally sufficient to meet the needs for water and land based recreational facilities. There is a need for additional swimming pools, playing fields, boat ramps, trails, and golf courses. Public and private investors are encouraged to supply these recreation facilities.

Environmental

The measures in the early action plan would provide varying degrees of flood protection to urban and rural areas in the basin so as to reduce the threat to life and property, thereby providing a greater economic efficiency in land use and increasing the disposable income of the landowners. This increase in disposable income will result in a higher standard of living and should improve social, cultural, and aesthetic values.

Protection and preservation of unique and scenic environmental areas, basin streams, National Forest lands, and wildlife management areas would improve the environmental quality of the basin. Such measures would also enhance conditions for protecting endangered species and unusual habitats, thereby safeguarding these intangible values for the enjoyment of future generations.

During detailed planning, the implementing federal and/or state agencies will re-examine each water resource development project and make appropriate modifications with special attention being given to viable alternatives as means of minimizing or mitigating adverse impacts on the environment. This will include consideration of all resource values necessary for the orderly development of water and related land resources.

Displays

A system of accounts sets forth a display of the beneficial and adverse effects of the early action plan. Four accounts are displayed as follows:

Display Number	Account Name
9.1	National Economic Development
9.2	Environmental Quality
9.3	Regional Development
9.4	Social Well Being

DISPLAY 9.1

EARLY ACTION PLAN

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Components	Measures of Effects (Average Annual) 1/2/
Beneficial effects:	Thousand dollars
A. The value to users of increased outputs of goods and services.	
1. Flood prevention	11,984.0
2. Streambank stabilization	3,700.0
3. Utilization of unemployed and underemployed labor resources	
a. Project construction	675.0
B. The value of output resulting from external economies.	
1. Indirect activities associated with increased net returns from flood prevention and streambank stabilization.	1,128.0
Total beneficial effects	17,487.0

Components	Measures of Effects (Average Annual) 1/2/
Adverse effects:	Thousand dollars
A. The value of resources required for a plan.	
1. Floodwater retarding structures and channels	
a. Project installation	5,708.0
b. OM&R	571.0
2. Streambank stabilization	
a. Project installation	1,236.0
b. OM&R	823.0
B. Losses in output resulting from external diseconomies.	
1. Indirect activities from reservoir take areas.	969.0
2. Increased transportation costs as a result of road relocation	9.0
Total adverse effects	9,316.0
Net beneficial effects	8,171.0

1/ 100 years @ 6 7/8 percent interest.
2/ Land treatment beneficial effects were not evaluated. Land treatment costs are 11,120,000 dollars.

DISPLAY 9.2

EARLY ACTION PLAN

ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse effects:	
A. Areas of natural beauty.	1. Protect 201,000 acres of bottomland hardwood forest. 2. Protect 1,100 acres of Geological systems. (Delta Bluff Hills). 3. Preserve wilderness areas 5,000 acres. (Delta National Forest) 4. Develop urban and green space 8,000 acres. 5. Protect 21 lakes - 21,400 surface acres and 1,735 acres of shoreline. 6. Create 81,000 acres of large water. 7. Provide scenic recreation trails through 70,000 acres of forestlands. 8. Flood protection will be provided for 970,000 acres improving the aesthetic quality. 9. Loss of 311,000 acres of bottomland hardwood forest. 10. Loss of present forest type vegetation along 2,119 miles of planned channel alterations.
B. Quality considerations of water, land, and air.	1. Reduce erosion on 294,000 acres of critical areas and gullies. 2. Stabilize 8,200 acres of road banks. 3. Stabilize 340 miles of stream banks. 4. Reduce erosion on 1.000,000 acres of cropland and pastureland. 5. Reduce erosion by installing 4,785 grade stabilization structures. 6. Reduce pollution from animal waste by installing 895 waste treatment units. 7. Conversion of 643,600 acres of forest land to other land uses. 8. Storage of entrained sediment in 227 floodwater retarding structures.

Components	Measures of Effects
Beneficial and Adverse effects:	
C. Biolcgical resources and selected ecosystems.	1. Dedicate 70,000 acres of forest land along recreation trails to biological and ecosystem resources. 2. Preserve the unique flora and fauna in 10 selected ecosystems - 9,900 acres. 3. Land use changes required for construction of 10,020 acres of large water - creating aquatic habitat in place of terrestrial habitat - 227 reservoir pools. 4. Restricted land use on 22,600 acres of flood pool area in 227 reservoirs. 5. Deterioration in quality of wildlife habitat as 506,200 acres are converted to pasture from other land uses. 6. Loss of forestland wildlife habitat as 643,600 acres of forest land is converted to other uses. 7. Reduction in overwintering waterfowl habitat as flooding of fields and woods is eliminated on 89,600 acres and is reduced on 880,400 acres. 8. Reduce quality and quantity of indigenous fish and wildlife habitat along 2,119 miles of planned channel alteration.
D. Irreversible and Irretrievable Commitments of Resources.	1. Conversion of 10,020 acres of terrestrial land use to water in 227 floodwater retarding structures. 2. Loss of 4,040 acres of land to channels. 3. Conversion of 71,000 acres of terrestrial land use and wildlife habitat for construction of other large water reservoirs. 4. Loss of 311,000 acres of bottomland hardwood forest.

DISPLAY 9.3

EARLY ACTION PLAN

REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects State of Mississippi	Rest of Nation
Income:	(Average Annual) 1/2/	
Beneficial effects:	Thousand dollars	
A. The value of increased output of goods and services to users residing in the basin.		
1. Flood prevention	11,984.0	0
2. Streambank stabilization	3,700.0	0
3. Utilization of unemployed and underemployed labor resources.		
a. Project construction	675.0	0
4. Additional wages and salaries accruing to the basin from implementation of the plan.		
a. Project OM&R (structures)	2,025.0	-2,025.0
B. The value of output to users residing in the basin from external economies.		
1. Indirect activities associated with increased net returns from flood prevention and stream bank stabilization.	564.0	564.0
2. Indirect and induced activities associated with utilization of basin unemployed and underemployed and other labor resources.		
a. Farm hired labor	1,406.0	-1,406.0
b. Project OM&R	994.0	- 994.0
Total beneficial effects	21,348.0	-3,861.0

Components	Measures of Effects State of Mississippi	Rest of Nation
Income:	(Average Annual) 1/2/	
Adverse effects:	Thousand dollars	
A. The value of resources contributed from within the basin to acheive the outputs.		
1. Floodwater retarding structures and channels		
a. Project Installation	1,142.0	4,566.0
b. OM&R	571.0	0
2. Streambank stabilization		
a. Project Installation	35.0	1,201.0
b. OM&R	823.0	0
B. Losses of output resulting from external diseconomies to users residing in the basin.		
1. Indirect activities from reservoir take areas	484.0	485.0
2. Increased transportation costs as a result of road relocation.	9.0	0
Total Adverse effects	3,064.0	6,252.0
Net Beneficial effects	18,284.0	-10,113.0

1/ 100 years @ 6 7/8 percent interest.
2/ Land treatment beneficial effects were not evaluated. Land treatment cost are 11,120,000 dollars.

Components	Measures of Effects State of Mississippi	Rest of Nation
Employment:		
Beneficial effects:		
A. Increase in the number and types of jobs.		
1. Agricultural employment	Utilization of 5,643 man-years of employment in agricultural production.	-
2. Employment for Project Construction	2,017 semi-skilled jobs (man-years).	-
3. Employment for Project OM&R	96 permanent semi-skilled jobs.	-
4. Indirect and induced employment for project installation and output of projects goods and services	169 permanent semi-skilled jobs.	-
Total beneficial effects	7,660 man-years of semi-skilled jobs. 265 permanent semi-skilled jobs.	-

Components	Measures of Effects State of Mississippi	Rest of Nation
Employment:		
Adverse effects:		
A. Decrease in number and types of jobs.		
1. Lost in agricultural employment of project take area	618 man-years of agricultural employment	-
2. Lost in indirect and induced employment associated with project take areas	140 permanent semi-skilled jobs	-
Total Adverse effects	618 man-years of semi-skilled jobs 140 permanent semi-skilled jobs	-
Net beneficial effects	7,042 man-years of semi-skilled jobs 125 permanent semi-skilled jobs	-

DISPLAY 9.4

EARLY ACTION PLAN

SOCIAL WELL BEING ACCOUNT

Components	Measures of Effects
Beneficial and adverse effects:	
A. Real Income Distribution	1. Create 125 low to medium income permanent jobs for basin residents.
	2. Create regional income benefit distribution of $21,348,000 by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
Less than 3,000	34	5
3,000 - 10,000	46	50
More than 10,000	20	45

3. Local costs to be borne by basin total $3,064,000 with distribution by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage Benefits in Class
Less than 3,000	34	5
3,000 - 10,000	46	50
More than 10,000	20	45

Components	Measures of Effects
B. Life, Health, and Safety	1. Increased outputs will be in soybeans, rice, cotton, and in livestock products.
	2. Reduce flood hazards on 970,000 acres.

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